Further Observations

ON THE USE OF

CARBOHYDRATES IN THE NAUSEA AND VOMITING OF PREGNANCY.

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ÆTIOLOGY.

In a previous paper one of us¹ has put forward in extenso the underlying principles which guide the treatment of nausea and vomiting of pregnancy. Those principles, briefly expressed, are that there are three fundamental factors to be considered, both from the standpoint of ætiology and of treatment.

1. *Metabolic Factor*.—This, the primary factor from the ætiological standpoint, shows itself as a glycogenic disturbance in the maternal liver. It expresses itself in the urine by the presence of β -oxybutyric acid and aceto-acetic acid. It is the origin of the fatty degenerated liver found at autopsy in fatal cases of pernicious vomiting. Its value is enhanced by starvation—the resulting carbohydrate deprivation intensifying the symptoms.

2. *Neurotic Factor*.—This was defined as an unduly sensitive sympathetic nervous system. Normal reflexes are heightened in pregnancy; the whole nervous system is in a condition of hypersensitivity, and such a condition reinforces the metabolic fault, for the influence of the sympathetic nervous system on the glycogen stores of the liver is well known. The influence of neurosis has been well recognised in vomiting of pregnancy ever since the time of Kaltenbach,² who strongly urged its importance. Indeed, it may become so important as to dominate the clinical picture and demand a major share of the therapeutic attention. Nevertheless, ætiologically it has been placed in a secondary position for reasons given in the previous paper already referred to, and in controlling the neurotic factor one must not lose sight of the metabolic disturbance. This is illustrated in Case N. N. The converse is also true, that exclusive attention to the metabolic condition will not result in a cure of pernicious vomiting of pregnancy in face of a continued state of high nervous excitement. See probabilities in Case Bk.

3. *Intestinal Intoxication Factor*.—This factor is now so well recognised that it seems almost superfluous to insist upon strict attention being paid to the condition of the bowel. This does not mean that a state of continual purgation be insisted upon. An occasional cathartic, and preferably one chosen by the patient herself, is usually all that is required if a diet high in vegetables is being taken. At the beginning of a treatment veg. lax. pil. I. or a mild aloin pill in the evening, followed by a simple cleansing enema the next morning, may be used with advantage, especially if the treatment is to include nutrient glucose enemata.

There is also the factor of *dehydration* in the severer forms of vomiting of pregnancy; how far this is a factor in the earlier forms—in which its clinical manifestations are not evident—has not been determined. It must be emphasised that more than one factor may be present in the same individual; indeed, it is usual to find the metabolic and the neurotic factors together, and both must be allowed for in the therapy.

Ætiologically, we have thus narrowed down the cause of nausea and vomiting of pregnancy to three, or, at the most, four fundamental factors; by so doing we exclude a number of causes to which the condition has at various times been attributed. We mean to imply not that there may not be other contributory causes in particular cases, but that these causes contribute their quota to the nausea and vomiting only in so far as they reinforce, either directly or indirectly, one or other of the aforementioned ætiological factors. In this manner we look upon the so-called “reflex”⁴ origin of pregnant vomiting. Malpositions of the uterus, inflammation of the cervix, endometritis, and other such maladies of the female generative organs—to which, at various times, the origin of vomiting of pregnancy has been ascribed—do not of themselves bring about such a disturbance. The pain and the fear that such a condition may lead to further untoward disturbance of the pregnancy or the patient herself, however, certainly must contribute to the neurotic factor; and surgical procedure, by relief of local symptoms, would aid materially in a cure of the vomiting, by thus lessening the nervous element in the case. The febrile condition is also an occasional contributory cause. It must be remembered that the first three months of pregnancy in woman are probably marked by a loss of nitrogen, if we judge human pregnancy by that of animals;⁵ if to this normal loss we add a second loss of nitrogen brought about by febrile reaction to acute infections we only intensify the condition. Moreover, the febrile condition is coincident with a diminution of “available water” leading to a disturbance of water balance.⁶ Certainly the water balance in fever is disturbed, in the direction of less water for urine formation, and this cannot help but reinforce any dehydration present in a severe case of vomiting, or make of it a factor which had previously been non-existent. Case C illustrates the effect of fever accompanying pyonephritis. We have also another case where the vomiting occurred with the onset of a mild attack of influenza.

Although we have in this manner separated out the various factors in the ætiology of nausea and vomiting of pregnancy, we have not explained why the condition only occurs in about 50 per cent. of pregnancies. The very fact that mild cases of nausea and vomiting are so common that they are held to be the almost inevitable accompaniment of child-bearing is evidence, in our estimation, that we are dealing with a temporary disturbance of a physiological balance. Undoubtedly, the nutritional condition of the woman at the time of conception will be a large determining factor in whether she develops nausea or not. Moreover, a number of cases have been observed where therapeutic abortion had to be performed on account of excessive vomiting in successive pregnancies of patients who later went through a further pregnancy successfully without any disturbance when a high carbohydrate diet had been in use for some time previous to conception. An ill-nourished, nervous woman would much more readily develop the condition than the better-conditioned and more phlegmatic type. Nevertheless, the phlegmatic type may show as much distress as the apparently less favoured group.

Theories of Causation.

Moreover, it has yet to be discovered what controls the relationship of hepatic and placental glycogen. Various theories of failure of internal secretion have from time to time been advanced as the cause of nausea and vomiting of pregnancy. The thyroid⁷ and the suprarenals⁸ have been particularised as the origin of the trouble, but there is nothing about either to suggest a connexion between them and the minor and major periodicity of nausea and vomiting of pregnancy which we have postulated as necessary to any theory. It is true that changes in the thyroid take place during pregnancy, but those changes do not correspond to either the minor or the major periodicity of nausea and vomiting of pregnancy. Moreover, the practical

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applications of such theories have not been as uniformly successful as should be expected.

Whatever may be discovered on the ultimate origin of nausea and vomiting of pregnancy—whether it is merely a question of malnutrition in the mother before or at about the time of conception, or whether some internal secretory organ which normally controls the relationships of the maternal liver and the placenta, is at fault—we feel certain that it is not due to any specialised toxins elaborated by the growing foetus or its appendages, combined with the failure of the mother to manufacture an antitoxin. The growth of foetus and placenta and uterine wall present no special metabolic peculiarities; the placenta contains a larger percentage of arginine than other tissues, but the amount is not excessive.

The newly pregnant organism does, however, show a condition of rapid growth superposed upon an adult organism which has ceased to grow. Metabolic strains are certain to be set up in the mother to meet the sudden and unaccustomed nutritional demands of the parasitic foetus. The mother must also equip herself with a means of defence against the newcomer. It is in this way that metabolic strains and stresses are produced, that nitrogen loss is observed at this period, and, as we believe, glycogen deficiency occurs in the maternal liver. It is particularly unfortunate that the term "toxæmia" has been used in connexion with this condition of pregnancy; the term "toxæmia" is inevitably associated with the word "toxin"—although it is correct enough if used in its original sense. The looseness of the term "toxæmia" has led to a corresponding looseness in thinking. It is not, however, usual to talk of the toxæmia of diabetes or the toxæmia of acidosis, though such a designation might be in order, as both conditions may lead to death. Both conditions, however, represent a disturbance of metabolic balance, and in this light we regard the condition of nausea and vomiting of pregnancy. Parallels between pregnant vomiting and cyclic vomiting in children and vomiting in the starvation treatment of diabetes⁹ are easily made, but in neither of the two latter do we assume any specialised toxin as the origin of the disturbance. The child later in life grows out of his cyclic vomiting—i.e., his metabolic balances adjust themselves, and diabetic vomiting ceases when we restore the suddenly further-disturbed metabolic balance by feeding. It is interesting to note that the eclamptic disturbances which may characterise the latter half of a pregnancy also occur at a period of rapid foetal growth. We thus do not see that in the present state of our knowledge it is necessary to make any further assumptions in the ætiology of nausea and vomiting of pregnancy.

TREATMENT.

The therapeutic measures which we have suggested to combat nausea and vomiting of pregnancy are fourfold.

1. The use of carbohydrate to correct the lack of maternal hepatic glycogen. This would range, depending upon the severity of the condition, from an alteration of diet in the direction of increasing cereals, vegetables, and fruit in mild cases, to the use of intravenous and interstitial glucose injections in the very severe forms.

2. Rest in bed with isolation in cases where the neurotic factor makes itself pronounced, and it usually does so in all but the very mild cases. As a sedative, bromide may be given by rectum in doses varying from 30 gr. once in the evening to 40 to 60 gr. t.i.d., depending upon the clinician's recognition of the severity of this factor and the patient's reaction to rest and isolation alone. As a general rule, however, the higher dosages are unnecessary. Their need is most evident when the patient vomits not only any fluid given by mouth, but when the vomitus begins to be in excess of this and the tissue fluids themselves supply the necessary water.

3. The keeping open of the bowel, usually in a gentle manner, by an occasional laxative for the mild cases, and an evening laxative, followed by a cleansing enema in the morning for the hospital cases.

4. The administration of water to correct any dehydration, and by doing so, to ensure the flow of all secretory and excretory fluids as far as the water factor in them is concerned. Fluids to the amount of 60 oz. are urged by mouth in all cases. Additional fluid in the severe cases will be supplied with the glucose, either by rectum or by interstitial or intravenous injection.

For the convenience of general readers we have included a rather contracted description of the method of treatment adopted in the different cases. This description is intended as a guide and not as a complete lexicon. No detailed directions can be evolved to suit each particular case, and the clinician's success in applying the treatment will in a great measure depend upon his grasp of the underlying principles and his skill in recognition of the value of the ætiological factors in each individual patient.

Classification.

Classify your case roughly into mild, moderate, and severe.

Mild.—All cases of simple nausea or "morning sickness" or those showing occasional vomiting; able to retain food,

Moderate.—Frequent vomiting, with or without continuous nausea; no epigastric pain or jaundice; able to retain food either only occasionally or only with difficulty. Dehydration may be present.

Severe.—Frequent or continuous vomiting. Epigastric pain, jaundice, inability to retain food, dehydration invariably present.

Make routine *urine examination* (on 24-hour specimen if possible). The mild and some of the moderate cases show a urine of medium specific gravity, normal colour, and give a test for acetone bodies by the Rothera test. Others of the moderate cases and all severe cases show highly coloured urine, high specific gravity (over 1025), and test for acetone bodies. Bile may also be present. Trace of albumin is invariably present, but no casts. Any case showing urine characteristic of the severe type should be classed as such for purposes of treatment, even though other findings would indicate classification as "moderate."

Treatment of Different Types.

Mild.—For three or four days leave out of diet all meat, fish, chicken, soups and broths, butter and cream. Before rising, patient to eat an apple, banana, or a few crackers. She must eat plenty of fruit, either fresh or stewed, vegetables, salads, bread, toast, crackers, rusks. May take jams, jellies, custard, and sparingly of milk and eggs. Diet to be taken in five small meals throughout the day instead of the usual three meals. Fluids: Water, weak tea, home-made lemonade or orangeade to make up 60 oz. a day. At end of three or four days ordinary diet may be resumed if taken in a number of small meals. *Fats must be taken sparingly.* Attend strictly to bowels at all times.

Moderate.—Rest in bed at once, with isolation. Any patient showing neurotic factor to be isolated in hospital. Make no attempt to feed by mouth, unless patient feels hungry and asks for food. Cleanse bowel by simple enema each morning. Give nutrient enemas of 6 to 8 oz. 10 per cent. glucose in saline t.i.d. Give very slowly by fine catheter. Murphy drip may be used if desired, but usually it is not well borne. Urge fluids by mouth to 60 oz. a day.

On subsidence of symptoms commence feeding by a little dry toast or crackers. If well borne, next day give mashed potato, a little jam or jelly with toast. Continue to increase the diet by consecutive additions of vegetables and fruit until the diet resembles diet in mild cases. Continue enemas until acetone bodies disappear from urine, then gradually discontinue, leaving night enema to end. Add protein to diet on disappearance of acetone bodies, starting usually with chicken or fish. Bromide, 30 gr., may be added to night enemas if indicated.

Severe.—Hospital treatment only. Strict isolation. Treatment as in moderate cases, but give either interstitial glucose, 500 c.cm. of 10 per cent. solution in saline, or intravenous glucose, 1000 c.cm. of 5 per cent. solution in saline, in addition to nutrient enemas, as above. Bromide up to as high as 60 gr. may be added to each enema if the symptoms are very severe and the urine continues to show a high specific gravity in spite of treatment. Codeine, $\frac{1}{4}$ -1 gr., may be given subcutaneously the evening following an interstitial or intravenous injection. The interstitial injection†

† In the preparation of sterile glucose solutions for intravenous use only the purest glucose must be used, and prolonged sterilisation must be avoided. It is most desirable to sterilise the saline solution separately, and then add the requisite amount of solid powdered glucose to the hot saline, and re-sterilise for a short period. The solution for intravenous use should be bright and clear, and should not be caramelised in any degree. Neglect of these precautions leads to undesirable after-reactions.

is very painful and should not be used more than twice. It sometimes has a salutary effect upon a refractory patient.

On subsidence of symptoms the feeding follows the directions of the moderate cases.

As dieting forms such an essential part of the after-treatment of the moderate and severe cases, and as diet will entirely and rapidly control the mild nausea and sicknesses, we have included a suggestive list from which the patient may select such dishes as suit her taste once she is well under control. It is important that such a choice should be exercised, as monotony of diet must be avoided, and the patient should not feel in the period of her convalescence that she is unduly restricted. We must urge that a carbohydrate diet does not mean a cereal diet exclusively. It must include vegetables and fruits at least twice a day. A diet instruction sheet similar to this is given each patient when she leaves the hospital, or to each patient when her morning sickness is under control, with a more exclusive carbohydrate diet.

Diet Instruction Chart.

The patient may exercise her choice of food under the following directions:—

Cereals.—Oatmeal porridge or any of the patent breakfast foods, taken with milk. Brown or white bread. Toast, rusks, cream crackers, biscuits.

Vegetables.—Any vegetable in any form except fried.

Fruits.—Any fruit, either fresh or stewed.

Meats.—Lean bacon or ham, beef, lamb, mutton, veal (no pork), chicken (avoid duck, goose, game). Any fish except salmon, mackerel. Eggs. Croquettes or rissoles if not fried in deep fat.

Soups.—Any soup, thick or clear, but free from fat.

Sweets.—Any jam or jelly. Marmalade or honey. Milk puddings. Boiled pudding occasionally. Pies or tarts may be taken occasionally (twice a week), but rich cakes and pastries must be avoided.

Salads.—Any salad, but sparingly of salad dressing.

Fluids.—Water, aerated water, home-made lemonade, orangeade, weak tea, coffee. Milk if desired. No alcohol of any kind. Butter may be taken if desired, but not in large amounts. Cream, fat meats, and any dish fried in deep fat should be avoided. Fruits and vegetables must be taken at least twice a day, and meat not more than once a day.

The above list gives ample variety. It is low in fat, medium in protein, and high in carbohydrate. By keeping up the high amounts of fruit and vegetable an ample supply of necessary vitamins is ensured for the growing foetus. In connexion with the vitamin supply of the growing foetus, we do not wish to strain an already overloaded theory, but we believe it is pertinent to inquire how far some of the manifestations of neuritis in pregnancy can be traced to a deficiency of water-soluble B in the diet of the expectant mother.

The treatment as thus outlined for the moderate and severe cases does not represent a radical change. The use of glucose, added to the already well-recognised treatment of the neurotic vomiting by rest and isolation, makes it, in our opinion, an advance on distinctly conservative and evolutionary lines. Indeed, if the literature be carefully searched many authors will be found to have recommended a plan of treatment very similar in character to that which we have just proposed. Thus the treatment suggested by Freund,¹⁰ Runge,¹¹ Winter,¹² Wallich,¹³ Stolz,¹⁴ and Lynch¹⁵ all contain the germ of the idea, though variations are to be noted in each. Those treatments, however, were more or less empirically developed and applied only to what would be termed pernicious cases. The treatment which we have proposed, and successfully used, has been developed on a physiological basis, and includes in its scope the mildest pregnant nausea as well as the most pernicious vomiting.

CONTROL OF TREATMENT.

The control of a treatment such as has been outlined is an important factor in its success. Mild cases of nausea or "morning sickness" present no special difficulty. The patient's symptoms are usually a sufficient guide. In dealing with moderate and especially severe cases of vomiting, however, the inexperienced physician requires some indications as to when to stop the treatment and when to pursue it

more vigorously if he is not meeting with the success he is expecting. At the end of this paper are reported four cases of vomiting of pregnancy illustrating phases of this problem. It is not necessary, though it is a decided advantage, to have a complete laboratory at hand for the study of the case. It is, however, necessary to have the fluid intake charted, to collect a 24-hour specimen of urine from day to day, and to determine its volume and specific gravity (preserve the 24-hour specimen with a little toluol in the collecting bottle). If the case is progressing satisfactorily it will be found that the fluid intake is high, that the volume of urine excreted increases, and, most significant of all, that the specific gravity decreases. It will invariably be found in such cases that the clinical condition improves with the alteration in the urine. In a later paper the more precise laboratory findings in some of these cases will be published; here we wish to confine ourselves to such determinations as are necessary for the successful conduct of a case, and can be carried out by any competent medical man with the assistance of a nurse or help to control the fluid intake and the collection of the urine. If, on the other hand, after five or six days' vigorous treatment by the methods given the patient's condition does not improve, the urine volumes remain low, and the specific gravities remain high, we should deem it advisable to carry out therapeutic abortion. (See Table III.)

Our observations confirm the futility of some of the older indications for the necessity of therapeutic abortion in vomiting of pregnancy.

Pulse-rate.—Several of the older observers¹⁶ have insisted that a pulse-rate persistently at or over 100 is an indication for abortion. Many of our cases show such a pulse, but there is no difference between those cases in which we found it necessary to abort and those in which success was attained. We have collected the results together in a table, arranging the cases roughly in order of severity of vomiting. (See Table I.)

TABLE I.—Average Daily Pulse-rate.

R	T	N	Br	G	NN	McK	Ck	M	I	C	Rd	Bk
82	95	82	88	102	98	92	89	104	74	93	84	84
78	90	81	87	68	98	94	70	90	80	90	97	83
78	80	84	87	90	117	93	82	100	79	124	104	82
84	83	77	69	92	103	86	82	102	86	100	116	93
84	88	84	84	91	100	84	84	96	86	111	109	68
82	92	86	74	93	104	84	84	81	87	100	107	61
				90	106	75	91		77	92	95	74
				77	108	82			75	97	86	92
				104	107	87			78	87	82	86
				94	96	84			87	120		91
				86	96	87			93	87		87
				90	93	79			88	97		
					95	76			89	109		
						76						
						79						

Therapeutic abortion performed on Cases Rd and Bk. Case C complicated by pyelonephritis; therapeutic abortion later for that cause. Case I, retroverted uterus; treatment successful. Treatment successful remainder of cases except G, which was probably a case of malingering.

Ammonia Coefficient.⁴—The fallacy of a high ammonia coefficient as a sign demanding therapeutic abortion in pernicious vomiting has been exposed again and again. Yet it still persists. Consequently, we have tabulated the ammonia coefficients of a number of our cases from day to day. The fallacy of passing judgment on a determination of one isolated specimen of urine is almost too glaring to be contemplated. Our coefficients are not extraordinarily high, nor is there any marked difference between our successful cases and our failures. The cases are arranged in order of their clinical severity. The highest coefficients were found in a case of moderate severity and persisted throughout the treatment, although the patient improved rapidly from a clinical standpoint. (Table II.)

Ammonia.—In view of the failure of the ammonia coefficient to act as an index for the necessity for therapeutic abortion, it has been suggested that the

daily ammonia output be used instead, as it is subject to less fallacies than the coefficient. The figures which we have obtained will be published later. We may say, however, that the course of the ammonia excretion does give a truer idea of the patient's metabolic condition and the effect of the treatment

TABLE II.—Daily Ammonia Coefficients.

R	N	Br	NN		Ck	M	Bk	
14.6	9.8	12.4	23.2	21.3	12.5	18.1	10.3	17.1
18.0	13.7	12.0	33.3	20.0	19.5	15.7	17.2	12.3
13.5	14.1	16.4	26.9	20.7	23.0	10.7	19.4	O.
11.3	13.0	13.4	29.0	18.2	18.0	11.1	21.2	15.8
10.9	11.3	14.2	31.0	16.3	11.1	9.1	23.6	10.3
10.5	13.4		27.6	9.1	8.7	10.7		
4.6	2.7		24.6		5.7			

Therapeutic abortion case Bk. Remainder of cases successful. O = Operation.

than the determination of the coefficient. The excretion of ammonia is one stage nearer the origin of the metabolic disturbance, but even this determination is not so significant as the determination of the excretion of the total acetone bodies. No further information, however, is to be gained from a clinical standpoint than can be obtained from the observance of the total 24-hour excretion of urine and the course of the specific gravity. Table III. shows how invariably in a successful case the specific gravity falls, and how in the two cases in which it was judged clinically advisable to perform therapeutic abortion the specific gravities remained at a high level.

TABLE III.—Specific Gravity of Urines from Day to Day.

R	N	Br	NN	McK	Ck	M	I	C	Bk
1017	1025	1029	1027	1005	1019	1024	1025	1015	1032
1024	1027	1017	1026	1004	1018	1017	1026	1013	1030
1015	1019	1015	1018	1004	1015	1012	1021	1019	1035
*1012	1017	1011	1013	*	1012	1009	R.U.	1018	1025
1010	*1014	—	1011	1006	1007	1009	—	1016	1023
1016	1015	*1022	1014	1005	*1011	*1009	1021	1017	1026
1014	1015		1014	1007	1012	—	1030	1012	1025
			1011	1008	—	1013	1022	*1010	1023
			*1012	1007	—	1010	—	1009	O.
			1011	—	—	—	1012	1015	1015
			1010	—	—	—	*1008	—	1010
								1016	

Last two figures of specific gravity given.

* Protein in diet. R.U. = Replacement of uterus. O = Operation.

Case I. was eating carbohydrates on third day. Operation on uterus caused return of vomiting. Case C complicated by pyelonephritis. Case McK following influenza. Water intake always very high.

RESULTS.

The results of the treatment of nausea and vomiting of pregnancy by thus taking into account the metabolic, neurotic, intestinal intoxication and dehydration factors in the same patient have been most encouraging. Thus Duncan¹⁷ reported a series of nearly 200 cases of all grades of nausea and vomiting treated in this manner with very few failures. He had had to perform therapeutic abortion in only one case in the past two years. Titus, Hoffman, and Givens,¹⁸ who have worked out a method of treatment almost identical with ours, reported in their first paper a series of 76 cases with two failures—one of these distinctly traceable to breaking of regulations. Since then they have added a further 68 cases with equally good results.¹⁹ The literature of pernicious vomiting contains many examples of enthusiastic reports of cures by many and various means. It contains also an approximately equal number of reports by independent observers, as thoroughly discouraging as the previous reports had been enthusiastic of the same method of treatment. This is due, we believe, to the unrecognised strength of the neurotic factor and to its being influenced by the personality of the medical man.

We have endeavoured to correct this personal factor by collecting the results of a group of obstetricians who have had experience for a year of the carbohydrate treatment—obstetricians competent but not specially skilled in laboratory work and each working independently. At the end of a year's experience a questionnaire was sent to each of them, and it was left to the individual judgment of each to decide the success or failure of his treatment. It is significant that not one of them has any thoughts of abandoning the method of treatment. In this way the results which we are publishing are *average results obtained under differing conditions of clinician, and of hospital, or home treatment.*

Table IV. shows 135 cases of all kinds treated throughout the year, with 98 successes, 25 improvements, and 9 failures. The figures given reveal one

TABLE IV.—Average Results of Treatment.

A. Mild Cases.

—	Clinician.					Total.
	A	B	C	D	E	
Cases	21	2	20	24	19	86
Successes	15	1	8	24	19	67
Improvements	6	1	12	—	—	19
Relapses	3	—	—	—	—	3
Transferred to hospital ..	3	—	—	—	—	3

B. Moderate and Severe Cases.

—	Clinician.						Total.
	A	B	C	D	E	F	
Treated at home	4	1	4	1	5	—	15
Treated at hospital	12	5	3	1	3	8	32
Successes	8	4	4	2	8	5	31
Improvements	2	—	3	—	—	1	6
Operations	4	2	1	—	—	2	9

fact in a very striking manner. They show the uniform success of the dietetic treatment in the mild cases of nausea and morning sickness, thus supporting the view that in its early stages the condition is a simple lack of metabolic balance and readily controlled. Indeed, so strongly do we feel this, that we believe, once the significance of the condition is generally understood, that pernicious vomiting will become as rare as is eclampsia in those centres where pre-natal care is rigorously insisted upon in the later months of pregnancy. It is not necessary that a woman should spend the first third of her pregnancy in a state of continual or intermittent nausea. Of the three cases given as relapses and requiring hospital treatment two recovered. There is thus a record of failure in mild cases of 1 in 87. It is also of importance to note that, as a result of the treatment and dieting, there were no after-effects of a disagreeable or harmful nature. The babies born of mothers undergoing this treatment were full term and normal in every respect.

Case NN.—This case is extremely interesting, as it shows clearly the influence of the neurotic factor and the value of suggestion in treatment of this condition, with its subsequent failure, unless the metabolic factor is at the same time brought under control. The patient was a young girl, the victim of assault. Soon after the assault she began to be nauseated with frequent vomiting. As this continued a local medical man was called in, who prescribed a mixture of bismuth and soda. Three weeks after the assault the patient had some hæmorrhage with slight uterine pains. As this hæmorrhage occurred at about the date of the usual menstrual period, a diagnosis of pregnant vomiting appeared to be ruled out. Nevertheless, the vomiting continued unabated, and her medical attendant decided to send her to the hospital. This so terrified the girl that it induced a strong reaction in her mind, and she promptly ceased vomiting and recovered, being out of bed and about the house for a few days. Within a week, however, the vomiting had returned as badly as ever and continued for about six weeks. During this time attempts were made to feed the patient on beef-tea and ice-water, but even these were not retained. Also during this period a second hæmorrhage occurred, simulating a second menstrual period. Finally,

the patient was sent to hospital for further examination. The threat of removal to hospital a second time did not produce any improvement in the condition. The patient, when seen in hospital, was rather thin and obviously very nervous. The physical condition was normal, except for some slight evidence of dehydration. The pregnancy was soon discovered and a diagnosis of pregnant vomiting was made. There had been no previous history of vomiting at any time. The urine showed a high specific gravity, a trace of albumin, and large amounts of acetone bodies. She was at once placed upon the routine treatment of water and lactose lemonade to 60 oz., with nutrient enemas 6 oz., glucose 10 per cent. in saline t.i.d., to which was added at night bromide 20 gr., chloral 10 gr. The morning enema was preceded by a soft soap enema.

In spite of the shock of the information as to her real condition, the patient made rapid improvement. She was moved to the isolation ward to give her as much rest as possible, and in two days was able to take a little toast without vomiting. She was also able to take plenty of water by mouth. The slight evidence of dehydration that had been present rapidly disappeared. She showed steady improvement, and was given on the third day a little toast, crackers, jam, and mashed potato. On the fifth day vegetables were added to the diet, and this diet was continued for a further three days. Protein was then added to the diet (a little chicken or fish) in spite of the fact that acetone bodies still continued to be present in the urine. During that time there was practically no nausea, but there was occasional vomiting in the early morning. The acetone bodies were present, though only in small amounts, for 22 days. Although the patient had shown such marked improvement and was practically free from any nausea or vomiting, nevertheless, in view of the continual presence of acetone bodies in the urine, enemas were continued for a much longer period than usual, and were not discontinued entirely, though they were reduced in amount until the acetone bodies had completely disappeared. The diet was progressively increased, and the patient was discharged about four weeks after her entry into the hospital. She was seen later and had kept practically free from any nausea or vomiting. During the later stages of her pregnancy she showed a tendency towards uterine hæmorrhage, and in consequence was ordered rest in bed occasionally. She was delivered normally and easily of an 8 lb. baby.

Urine Chart (Case NN.).

Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.	Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.
Feb. 9	500	1027	+	+++	Feb. 21	520	1013	+	+
10	515	1021	+	+++	22	870	1013	+	+
11	525	1018	+	+++	23	620	1012	+	+
12	840	1013	+	+++	24	820	1015	+	+
13	1250	1011	+	+++	25	1210	1013	+	+
14	550	1014	+	+	26	400	1016	+	+
15	600	1014	+	+	27	620	1019	+	+
16	860	1011	+	+	28	—	—	+	+
17*	810	1012	+	+	Mar. 1	—	—	+	+
18	580	1014	+	+	2	—	—	+	—
19	970	1011	+	+					
20	980	1010	+	+					

* Protein in diet. Alb. = Albumin. Acet. = Acetone.

Case Bk.—This case represents a failure of the treatment under conditions which were almost hopeless from the commencement. The patient, aged 27, 2-para, housewife, had had her previous pregnancy terminated by Cæsarean section at eight months after continuous vomiting. A living child had been obtained. The patient was extremely thin, ill-nourished, and nervous. No jaundice or epigastric pain was present. Vomiting was frequent, though without nausea. Her present pregnancy was of about two months' standing and the vomiting had started suddenly a week previous to her entry into the hospital, and no food had been taken since. Her private physician had sent her in for therapeutic abortion.

Examination showed a pelvis so contracted that the only possibility of obtaining a living child lay through a second Cæsarean section. The patient was aware of this fact and desired abortion. The urine showed a strong acetone reaction, otherwise it was negative. She was given on the evening of her admittance 1 gr. of codeine, but otherwise no treatment. The following day the routine treatment of 10 per cent. glucose in saline by rectum 6 oz., with bromide and chloral, as in the previous cases in the evening, was given. The vomiting was not excessive. The enemas were well retained, and a fluid intake of 26 oz. was obtained. The acetone bodies showed a very strong reaction in the urine. The next day showed about the same clinical condition as the previous one, though the amount of vomitus was large. The vomiting increased the day afterwards. The patient was looking

exceedingly miserable and was now unable to take tea, lemonade, or orangeade. 300 c.cm. of 10 per cent. glucose in saline were given interstitially this day, with ½ gr. of codeine at the same time, and a further ½ gr. at night in addition to the usual enemata. This seemed to improve the vomiting for a short time, and the enemata were changed to a 10 per cent. glucose in saline given by Murphy drip, two hours on and one hour off. Codeine was still used at night. There was again a little improvement in the morning, but the afternoon showed great relapse and an operation was decided upon. The day previous to the operation 1000 c.cm. of 5 per cent. sterile glucose in saline were given intravenously. This seemed to effect a little improvement, but did not produce any marked change. No treatment was given the day of the operation. The treatment by nutrient enemata was recommenced the day after. The effect of the operation, as is usual in the majority of these cases, was remarkable. The vomiting ceased and the patient became quite cheerful. She was able to eat small meals of crackers, toast, mashed potato, and a little milk and water. The urine contained just a trace of acetone. The day following she was able to go on a vegetable diet, and following that, meat and chicken were added. Recovery was uneventful. It is to be remarked in this case

Urine Chart (Case Bk.).

Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.	Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.
Jan. 24	—	1032	—	+++	Jan. 30	260	1025	tr.	++
25	400	1030	tr.	+++	31	525	1023	..	++
26	570	1035	..	+++	Feb. 1†	—	—	—	—
27	450	1025	..	+++	2	1000	1015	tr.	+
28	375	1023	..	++	3	670	1010	..	—
29	565	1026	..	+++					

† Operation day, no specimen. tr. = Trace.

that treatment by glucose by all ways was unavailing before the operation, and made no effect upon the patient either clinically or metabolically. The acetone bodies and the nitrogen output ran a very irregular course, maintaining a high level. Within 24 hours after the operation very mild carbohydrate treatment was sufficient to abolish all evidences of starvation. It is supposed that the patient's mental condition was such that it precluded all attempts to correct the metabolic errors. The metabolic condition might possibly have been overcome had we used continuous dosages of bromide, much heavier than in any of our other cases, and had we given a series of intravenous injections of glucose.

CASE I.—This again is a very interesting case, which under the old classification would be described as reflex vomiting; nevertheless, it yielded rapidly and easily to metabolic treatment. The patient was 2-para, but the first pregnancy ended in a spontaneous abortion at two months. It had been marked by much vomiting after meals. There was also a previous history of cyclic vomiting as a child. In the present case she had been treated at home without any success by a local physician, and was expecting to be aborted, though she was very desirous of the living baby. Aged 22, two months pregnant, a thin, very nervous woman, the lips cracked, the tongue coated and dry, breath very foul, epigastric pain on pressure. The conjunctivæ, however, were clear. Bimanual examination showed the presence of retroverted impacted uterus. As, however, she was quite comfortable lying in bed the condition of the uterus was not disturbed for a few days. She vomited much during her first night in hospital, but seemed easier in the morning, and took orangeade without vomiting. She was given nutrient enemas, 6 oz. glucose 10 per cent. in saline t.i.d. On account of her very nervous condition, and in view of the possibility that an intravenous or interstitial glucose injection might have to be given to combat the obvious dehydration, bromide, 30 gr., was added to each enema. Water was urged to 60 oz. The urine showed a low volume, high specific gravity, albumin, and acetone bodies. A few casts were also observed. At the end of the first day's treatment the patient seemed much brighter; she vomited once on the morning of the second day. She slept fairly well. The treatment was continued; the second day was marked also by further improvement, and she was able to take a little toast and weak tea for supper without any vomiting. On the third day the epigastric pain had disappeared, and she was bright, cheerful, and hungry. She was given toast and jam. She vomited once in the early morning. Nausea, however, had entirely disappeared, and she was well on the way to recovery. The acetone bodies were present only in traces.

As this case had so far followed the usual course expected during recovery, it was felt that the recovery from nausea and vomiting could be claimed in spite of the retroverted uterus. The patient, unable to retain anything by mouth before her entrance into hospital and before treatment, was enabled in

three days to take small meals in comfort. It was, however, not deemed advisable to leave the condition of the uterus any longer, and an operation was performed. It was found impossible to turn the uterus by manipulation, and consequently laparotomy with the Baldy-Fisher technique was carried out. Gas was used as the anæsthetic. The vomiting, as a result of the operation, recommenced, and continued increasingly for several days. Violent tremblings were also observed. Two days after the operation the nutrient enemas were recommenced with bromide as before. In addition, 1 gr. of codeine was given each night. Although the sedatives brought the continuous trembling under control, the treatment by the nutrient enemas did not improve the vomiting for three days. In fact, it seemed to progress. Six days after the operation, in addition to the enemata, 1000 c.cm. of 5 per cent. sterile glucose in saline were given intravenously. It was followed by a slight reaction. The patient vomited a little the morning after, but not subsequently. The urine rapidly improved together with the clinical condition. Two days after the intravenous injection she was able to take mashed potato, toast, crackers, jam, and jelly, and on the following day was given a little chicken. The bromide was discontinued, and the patient made an uneventful recovery, though there was occasional slight discomfort.

Urine Chart (Case I).

Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.	Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.
May 9	—	1025	++	++	May 16	—	1021	..	++
10	760	1026	+	++	17	—	1030	+	++
11	—	1021	+	+	18	—	1022	..	+
12	—	R.U.	—	—	19	—	—	..	..
13	—	—	—	—	20	570	1012	..	+
14	—	N.U.	..	..	21	550	1008	..	—
15	—	—	—	—					

R.U. = Replacement of uterus. N.U. = No collection of urine.

CASE C.—This case shows an interesting example of the failure of the treatment in the presence of an active pyelonephritis. The patient, aged 23, 2-para, was two months pregnant. She had been vomiting for about a month to the extent of six or seven times a day, and was unable to keep down even water. Her previous pregnancy had been marked by nausea and a little vomiting, but not to the extent of this one. There was no previous history of bilious attacks or vomiting as a child. Physical examination showed a distinct tenderness over the liver area and also over the left lower quadrant. The uterus, however, was normal. The breath was foul, and the patient complained of a bad taste in her mouth. The tongue was coated but moist, the skin moist and clear, but the lips were extremely dry and cracked. The conjunctivæ showed a trace of bile. The urine did not show an extremely high specific gravity, though acetone bodies were present in large amounts. There was also present a trace of albumin and bile. The usual course of treatment by rectum was commenced and water urged by mouth. This was continued for two days without any improvement. Bromide, 30 gr., was then added to each enema, and on her third day of treatment 500 c.cm. of 10 per cent. glucose were given interstitially. Following this the patient was, if anything, slightly worse. Fluids were urged vigorously, as both skin and mouth began to show signs of dehydration. On the fifth day of treatment an intravenous injection of 1000 c.cm. of 5 per cent. sterile glucose in saline was given, in addition to the usual enemata. There was a slight reaction from the intravenous glucose and the patient vomited a great deal. The day following, however, she seemed much better. The specific gravity of the urine was slowly going down, the acetone bodies had nearly disappeared, and the bile had completely gone. Moreover, her epigastric pain had improved greatly. From this point she seemed to pick up and commenced to feel hungry, and was able to take food such as toast, mashed potato, and jelly. A little chicken was given on the eighth day. On the ninth day the patient had practically ceased vomiting and was enjoying her food. All this time, however, she had been complaining of tenderness in the kidney region, and an examination had shown the presence of a pyelonephritis which now became more manifest. Some slight temperatures developed and the patient complained of aches and pains in the wrists, hips, and shoulders. A bacteriological report showed the presence of *B. coli* in a catheter specimen of urine with the albumin increased. Some days previous to this sodium bicarbonate, 60 gr., had been added to the enemas. This was discontinued and pot. cit., 30 gr. q.4.h., was given by mouth. On account of the pyelonephritis the fluid intake, which had previously been urged to 60 oz. to combat the obvious dehydration, was restricted to 30 oz., but this was later increased to 50 oz., as the signs of dehydration began to make themselves again apparent and the vomiting returned. The vomiting continued again coincidentally with the febrile con-

dition. As this latter was brought under control and water and glucose enemata again urged, the vomiting also died down, and for a second time the patient was able to take food. Again, however, the pyelonephritis disturbed the balance and a second attack of fever commenced. Again coincidentally with it, the patient became nauseated and vomited frequently. By this time the patient had become greatly depressed and very much weakened, and it was decided to perform therapeutic abortion. In view of the patient's age and the evidently serious nature of the pyelonephritis, it was felt that we would not be justified in pushing the treatment of the vomiting to the necessary extent and continuing the pregnancy. After the operation the patient did not recover with extreme rapidity. She still continued to vomit for three or four days and acetone bodies still appeared in the urine. From that time, however, she improved, the acetone bodies disappeared, and as far as the nausea and vomiting of pregnancy were concerned she recovered. She was transferred to the women's medical ward for thorough examination and treatment of her nephritic condition.

Urine Chart (Case C).

Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.	Date.	Amt. c.cm.	Sp. gr.	Alb.	Acet.
Mar. 31	180	1015	tr.	++	April 14	130	1016	+	+
April 1	80	1013	+	+++	15	220	1015	..	+
2	240	1019	+	++	16	130	1014	..	tr.
3	100	1018	+	+	17	—	—	+	—
4	90	1016	+	+	18	—	1017	+	—
5	220	1013	+	tr.	19	450	1013	+	tr.
6	—	1012	+	+	20*	—	—	..	..
7	460	1010	++	—	27	670	1020	+	+++
8	—	1009	++	—	29	—	Op.	..	..
9	—	1015	++	—	May 2	800	1018	+	+
10	270	1015	..	—	3	600	1017	+	+
11	350	—	++	+	4	500	1012	+	tr.
12	V.S.	—	..	++	6	400	1011	..	—
13	600	1016	+	+	7	650	1014	..	..

* No urine collection April 21st to 28th, May 1st, 5th. V.S. = Very small. Op. = Operation.

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