A CONTRIBUTION TO THE STUDY OF ICTERUS NEONATORUM.

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THE following observations were made with the object of throwing further light upon the pathology of icterus neonatorum, and more particularly to determine the question of its hæmic or hepatic origin.

By the term icterus neonatorum I mean a discoloration of the skin, appearing from two to five days after birth, varying in hue from a slight sallowness to a decided yellow, disappearing gradually in about two weeks, and unattended by any marked symptoms of constitutional disturbance. In the milder cases the urine does not contain bile pigment, at least in sufficient quantity to stain the child's clothing, while in the more pronounced cases the napkins are decidedly stained by it. This definition excludes all cases of congenital imperfection of the biliary passages, all inflammatory affections of the liver, and gastro-duodenal catarrh; in a word, all cases of jaundice by obstruction. This being the case, it remains to consider whether there is any other form of mechanical jaundice than that by obstruction, and, if so, whether icterus neonatorum can be classed under it.

A few words are here necessary as to the classification of jaundice from the point of view of its etiology.

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I.—*The mechanical or hepatogenic form.*

This is universally recognized, in so far as it is produced by any agency increasing the pressure in the bile ducts, and thereby favoring the entrance of the bile into the lymph- and blood-vessels. The converse of this, namely, that icterus may be caused by diminished blood-pressure in the portal vein, is by no means so generally acknowledged. Pylethrombosis, which is sometimes brought forward as a typical cause of the latter form of jaundice, is so in a theoretical sense only, for it is extremely doubtful whether such thrombosis is ever primary.

The occurrence of jaundice in fasting animals has been attributed to diminished blood-pressure in the portal vein, due to enfeebled action of the heart, and, therefore, classed under the head of hepatogenic or mechanical jaundice; but there is quite as good reason for classifying such cases under the head of hæmatogenic jaundice, for in them a rapid diminution in the number of the red blood cells can be demonstrated, while the diminished portal pressure is only inferential.

II.—*Hæmatogenic or chemical jaundice.*

Opinions are divided as to the existence of a form of jaundice in which the abnormal hue of the tissues is derived directly from the coloring matter of the blood. Nevertheless, there is very convincing evidence, both experimental and clinical, to be adduced in support of such a variety of the disease. For example, the injection into the veins of substances which are known to disintegrate the red blood cells, is followed by jaundice. The simplest of these substances is water. The red blood cells, when submitted to the action of water outside of the body, lose their coloring matter; and corresponding with this observation is the fact that injection of water in considerable quantity into the

veins, is followed by jaundice. The same result is produced by the vapors of chloroform and ether when brought in contact with blood contained in a gas chamber; and jaundice occasionally, though it must be admitted very rarely, follows prolonged anæsthesia by these agents in the human subject.

The jaundice of acute phosphorus poisoning, of malarial hæmaturia, and that occurring after the bites of venomous reptiles, is probably hæmatogenic; although in the first-mentioned variety, owing to the fact that phosphorus is an irritant to the gastro-duodenal mucous membrane, it is the opinion of some that the jaundice is hepatogenic or mechanical. In a case of acute phosphorus poisoning, which was recently under my care at the Episcopal Hospital, there was an intense degree of icterus; nevertheless, at the autopsy the gall-bladder was found empty, which would certainly not have been the case had the jaundice been of mechanical origin.

III.—*Jaundice by suppression.*

Harley is the most prominent advocate of such a variety of icterus. He considers that the bile pigment, like cholesterin, is preformed in the blood, and is merely separated by the liver. E. Wagner[1] regards the opinion that there is such a form of jaundice as no longer tenable, and refers to experiments upon the removal of the liver by Müller, Kunde, and Moleschott. The question may be regarded as still open, although the advocates of this form of icterus will probably admit that there are two forms of jaundice by suppression; one in which the accumulation of pigment is due to imperfect action of the liver, therefore *hepatogenic;* another in which more pigment is formed in the blood than can be separated by even a healthy liver, therefore

[1] "Manual of General Pathology," Am. ed., p. 557.

hæmatogenic. The advantage, therefore, of this supposed variety is by no means apparent.

From the foregoing remarks it is, I trust, manifest that I hold to the division of cases of jaundice into hepatogenic or mechanical and hæmatogenic or chemical, and believe that further study will settle either the exclusive or, at least, the preponderating influence of one or other of these causes in every case of icterus.

To produce experimentally the first of these two forms of icterus, it would be necessary to increase the bile-pressure *absolutely* by ligature of the hepatic or common bile-duct, or to increase it *relatively* by cutting off a portion of the portal blood-supply. Now, this latter experiment is performed in the case of every human being by ligature of the umbilical cord. The portal blood-pressure is suddenly and markedly diminished; abnormal conditions of osmosis are established, and when jaundice ensues it is only necessary to prove that the number of the pigment-carriers, *i. e.*, the red blood cells, has not been reduced, in order to settle the question of the mechanical origin of icterus neonatorum.

This is what I have done, by counting the blood cells in a few new-born children, and because, so far as I can ascertain, it has never before been done; there is scarcely an affection of which the etiological status is more uncertain.[1]

The following observations were made at the Maternity Hospital[2] in the autumn of 1881.

CASE I.—Oct. 19, 1881. Alice K., born at 8 A.M. Count made at 10:30 A.M. The child was of average size and not cyanosed. Labor had been natural and easy. No symptoms of suspended animation. Child crying lustily when born. Weight, 8¼

[1] I refer, of course, to counting the blood cells in the neonatus with especial reference to the cause of icterus neonatorum, although unaware of its having been done for any purpose.

[2] Formerly called the State Hospital for Women and Infants. For the opportunity of making these observations, I am indebted to the courtesy of the officials of the institution, and particularly to Dr. J. V. Ingham.

lbs. The blood was obtained by puncture of the great toe, and was venous-looking. (The average number of red blood cells per cubic millimetre is, in the adult, *at least* 5,000,000.)

Number of red cells per cubic mm., 6,410,000.

No white in specimen examined.

Oct. 20th, 10:30 A.M. Second count in the same case. Child thriving.

Number of red cells per cubic mm., 5,810,000.

Oct. 22d. Third count in the case of Alice K. Child doing well; no appearance of jaundice.

Number of red cells per cubic mm., 5,680,000.

The above case proves that a rapid and great diminution in the number of the red blood cells may occur during the first few days after birth, without the supervention of jaundice. That this diminution in the number of cells per cubic mm. was not caused by the absorption of water, is proved by the following facts: The child before birth is suspended in the amniotic fluid, and therefore in a condition far more favorable to the absorption and retention of water in the system than after its removal from the body of the mother. During the examinations of the blood, the only fluid ingested by this infant was that obtained from its mother's breasts, and this, the colostrum, was of small amount. On the other hand, water passed freely out of the system through the kidneys and skin, so that the conditions were eminently favorable to the production of an increased percentage of blood cells, a kind of spurious plethora, through diminution in the normal amount of water in the blood. Nevertheless, the percentage of red blood cells was reduced, and therefore they must have been destroyed.

CASE 2.—John G., born Oct. 20th, at 12 (mid-day). Labor easy and natural. Child not asphyxiated; weight, 8 lbs. Count No. 1 made at 11 A.M., Oct. 21st.

Number red cells per cubic mm., 5,925,000.

This count corresponds closely with count No. 2, in case No. 1, which was made about the same time after birth.

Count No. 2, Oct. 23rd.
Number red cells per cubic mm., 5,520,000.
Faint yellowish tint of skin.
Count No. 3, Oct. 25th.
Number red cells per cubic mm., 4,870,000.
Child deeply jaundiced.

CASE 3.—Mary C., born 5:20 A.M., Nov. 5th. Count made at 2:30 P.M., Nov. 6th. Child weighed 6¾ lbs. at birth. Labor natural.
Number red cells per cubic mm., 3,625,000.
Proportion of white cells to red, 1 to 145.

This case was undoubtedly one of *congenital anæmia.* The child's only appearance of mal-nutrition was a shrivelled state of the integuments of the feet and a less rosy color of the skin than normal. For a new-born child it was decidedly pale. This shrivelled state of the skin emphatically negatives the idea of a relative anæmia from excess of fluid. The blood was probably deficient in quantity (oligæmia) as well as defective in quality (oligocythæmia). There was also a decided increase in the number of the white cells. Careful inquiry proved that there had been no hemorrhage from the cord. As possibly bearing upon the congenital imperfection of this child, I may mention the facts that the parents were themselves immature—the father being seventeen and the mother eighteen years old. But one examination could be obtained in this interesting case, and therefore it has but a remote bearing upon my subject. I introduce it for its own inherent interest.

CASE 4.—Wm. S., born Nov. 6th, 5 A.M.; weight, 6½ lbs.
Count No. 1, Nov. 7th. Number red cells per cubic mm., 4,520,000.
White cells to red, 1 to 904.
Count No. 2, Nov. 8th, 11 A.M. Number red cells per cubic mm., 5,335,000.
White cells to red, 1 to 711.
Child slightly yellow.

CASE 5.—Sela F., female, born Nov. 17th, 8:15 A.M.; weight, 7 lbs.; labor rapid and natural ; child healthy-looking.

Count No. 1, Nov. 19th, 10:30 A.M.

Number red cells per cubic mm., 5,185,000.

Number white cells to red, 1 to 350.

Count No, 2, Nov. 21st, 4 P.M.

Number red cells per cubic mm., 5,495,000.

Number white cells to red, 1 to 628.

Slight icteric hue of skin.

From the foregoing observations no argument can be advanced in favor of the hæmatogenic origin of icterus neonatorum ; for while it is true that in case 2, the only one in which there was marked jaundice, this condition coincided with a rapid and great diminution of red cells, it is also true that in case 1 there was a very decided loss in red cells without the occurrence of jaundice, and that in cases 4 and 5, with a slight degree of icterus there was an increase in the number of red cells.

The next questions which naturally arise in connection with this subject are : If this icterus is not hæmatogenic, why does it not invariably occur, since the umbilical vein is ligatured in all new-born infants, and why has the statement been made and corroborated by excellent observers, that it is more frequently met with in delicate children than in the robust ?

I admit both of the facts implied in the above questions, and propose the following explanation :

The degree of immediate interference with the portal circulation produced by ligature of the umbilical cord, depends both upon the anastomoses of the umbilical vein with the veins of the abdominal wall, and upon the vigor of the cardiac contractions. Where there is free anastomosis and a vigorous heart, the intravascular blood-pressure in the hepatic lobules may be maintained to such an extent as to prevent the absorption of bile, and *vice versâ*. I may here

mention, as bearing upon this subject, that the size of the heart, which in the adult is as 1 to 160, in the fœtus is as 1 to 120. This preponderance of cardiac force in the new-born child is a provision of nature for the establishment of new circulatory channels, rendered necessary by the ligature of the cord and the beginning of respiration.

Facts are not wanting to show that the umbilical vein often continues pervious through life, but it is to be regretted that they are not given with more attention to detail. Thierfelder states that it continues patulous in "most human beings." Bamberger has "frequently found the umbilical vein in adults pervious to a fine sound"; and Hoffmann has reported a case of cirrhosis, in which he demonstrated an anastomosis between the greatly dilated umbilical vein and the inferior epigastric. In cases of cirrhosis, a patulous condition of the umbilical vein and anastomoses with veins of the abdominal wall, may, through the establishment of a reverse venous current, be in a high degree conservative.

It is true that Sappey has denied that a vein frequently found in the ligamentum teres is identical with the umbilical vein, but there can be no doubt regarding the case of Hoffmann, for he traced the vessel to its communication in the transverse fissure with the portal vein, and through the open ductus venosus, with the vena cava inferior.[1]

As an instance of the confusion attending the subject of icterus neonatorum, I may mention, that while one set of observers attribute its causation to the sudden diminution of blood-pressure in the hepatic vessels produced by ligature of the cord, Dr. West [2] states that "in many instances of it the fœtal passages are still pervious, and the blood

[1] For reference to cases of patulous umbilical vein, see *Ziemssen's Cyclopædia*, Am. ed., vol. ix, p. 185.

[2] "Lectures on the Diseases of Infancy and Childhood."

circulates in part through channels which ought to have been closed from the time of birth."

The knowledge that the umbilical vein continues pervious in " many instances " of icterus, can only have been obtained by means of autopsies, and it is to be regretted that the general statement is not supported by some particular facts. Since none such are given, I am not inclined to accept it.

For the umbilical vein to continue pervious after ligature of the cord, there must be anastomoses with veins of the abdominal wall, and in order that this collateral venous circulation be at once established, there must be a certain degree of vigor on the part of the heart. Where one or other of these factors is wanting, thrombosis will occur in the vein, and, therefore, the unsupported statement that the umbilical vein continues pervious in many instances of icterus, is opposed to the undoubted fact that the affection is most common in weakly infants.

In my argument I, of course, assume that the current of blood in the umbilical vein, when this remains patulous after birth, is, as before, toward the liver. This, although not susceptible of proof, is much more reasonable than to suppose a reversed current, as in cases of cirrhosis.

In cases in which the umbilical vein does not remain permanently patulous, the usual period of its obliteration may be prolonged, owing to the above-mentioned anastomoses, and this more gradual obliteration may prevent the occurrence of this form of mechanical jaundice.

The fact of varying degrees of icterus neonatorum, harmonizes completely with the theory of a venous anastomosis more or less extensive, and a cardiac contraction more or less powerful; while on the theory of a hæmatogenic icterus, it is impossible to explain why, of new-born children under precisely similar conditions, some should be the victims of a blood dyscrasia, whose only sign or symptom is a discolora-

tion of the skin, while others should present nothing of the sort.

As to the frequency of icterus neonatorum, opinions vary from the one extreme of denying its existence to the other of believing that it is more or less present in all new-born children, its lighter grades escaping detection because they are not carefully looked for. I cannot concur in this latter opinion. While it is true that there are none so blind as they who will not see, it is also true that the willingness to see is at least as productive of positive results as is the unwillingness to see, of negative. Leaving the will, however, out of the question, it is undoubtedly the case that icterus neonatorum is far more common than is generally supposed.

Harley does not consider the affection a form of jaundice at all, and objects strenuously to the term icterus neonatorum, which he calls a "learnedly sounding name," and proposes for it that of *chlorosis* neonatorum, which, to the ear of the writer, has quite as learned a sound, and conveys impressions concerning the pathology of the affection which are not substantiated by a single fact.

The known fact that the portal blood-pressure is suddenly diminished by ligature of the umbilical cord, and the further facts recorded above as to the number of the blood globules in the neonatus, lead me to the conclusion that icterus neonatorum is of the mechanical or hepatogenic form, and that the term chlorosis neonatorum, proposed by Harley for this affection, is a misnomer.