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A New Chart for Indicating Exchange Transfusion in Neonatal Hyperbilirubinaemia

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A new chart has been constructed for the indication of exchange transfusion in haemolytic disease of the newborn and neonatal hyperbilirubinaemia. Three separate lines showing the border limits of serum bilirubin values make it possible to consider individually in each case the maturity of the infant, expressed as body weight or gestational age, clinical and serological data and, if serial estimations have been performed, the dynamics of bilirubin metabolism.

Two seemingly controversial trends have prevailed in the practice of indicating exsanguino-transfusions in the management of neonatal icterus gravis during the last decade.

(i) The first was lifting step by step the obligatory acceptance of the 20 mg/100 ml serum bilirubin level as an absolute borderline for the intervention, especially in cases with ABO immunization or without any immune-haemolytic background [8, 9, 23].

(ii) At the same time a second has been advocating an early exchange transfusion in hypoxic-acidotic low birth weight infants who, as recent works have shown, are exceptionally inclined to developing kernicterus at a comparatively low pigment level [1, 16, 19].

Apart from the above tendencies, the protocol of exchange transfusions varies significantly in different institutes of the world as the data collected by STUR [20] have shown it so distinctly. Recommendations found in text-books are far from unanimous, though indications are given by all of them on the basis of a certain serum bilirubin level at a certain age. However, maturity, body weight and clinical circumstances are not appreciated uniformly in these works [3, 4, 12, 18, 20].

The most quoted example of the pragmatic approach to the indication of an exchange transfusion in neonatal hyperbilirubinaemia originates from MCKAY [9] where two categories are used for the grouping of cases: term/preterm and healthy/feeble infants.

Other authorities suggest the pigment level to serve as a relative and absolute indication with a between zone where one may speculate on additional factors and practice a wait and see policy. The best examples of this kind of diagram are the chart of ALLEN and DIAMOND [2] con-

structed for babies with Rh-isoimmunization and that of POLAČEK [14] which applies to ABO immunization as well.

The new chart constructed by the present authors, beside the above conditions, includes their experience gained in the treatment of babies with hyperbilirubinaemia and allows for a differentiated judgement in cases of immunization.

On the basis of the pathomechanism of neonatal jaundice we have divided the neonatal period into three parts.

(i) The first few hours post partum, when serum bilirubin and haemoglobin values are considerably influenced by intrauterine haemolysis and the functional capacity of the placenta;

(ii) a second period which lasts until the end of the second day of life, when excessive extrauterine haemolysis may dominate the clinical picture; and

(iii) the next part of neonatal life when the glucuronization process has a growing importance in the course of jaundice.

Concerning the indications immediately after birth, two points have to be stressed, i.e. the uselessness of the cord serum bilirubin level as the only parameter for indicating an intervention, an experience reported by us previously [16]. The same is true for a positive Coombs-test, which cannot be considered a sufficient indication either since 40 to 50% of the positive babies need no exchange transfusion, as DUNN's recent paper [5] has proved it clearly. Passivity is of course undue if grave anaemia, a low haemoglobin level, hydrops or menacing jaundice are evident already at birth [22]. In the lack of the mentioned signs we suggest to estimate the bilirubin level repeatedly at 4 to 6-hour intervals, as even 6 mg/100 ml cord values are sometimes misleading.

When in the course of serial studies a rise of the pigment level by 0.4—0.5 mg/100 ml/hr is observed, this points to a degree of haemolysis which cannot be treated without a blood exchange. A rise of 0.75—1.0 mg/100 ml/hr which is regarded by some textbooks [3, 18] as the lowest limit indicating the intervention, is an exaggerated requirement which would lead by the end of the first day to an unacceptable degree of jaundice, i.e. 22—28 mg/100 mg (Fig. 1). Curiously, the same textbooks are not so lenient when they express the indication on a mg pigment level/hour of life basis.

An analysis of our immune-haemolytic patient material yielded a limit extending from 6 to 14 mg per 100 ml on the first, and from 14 to 18 mg per 100 ml during the second, day of life. If serum bilirubin values had once or even twice surpassed that limit, an exchange transfusion was mandatory in the majority of cases. In patients with ABO isoimmunization, or mild Rh isoimmunization the above limits may be raised by 2—4 mg (Fig. 2). This experience served as the basis for plotting the first part of our new diagram.

During the third and later days of life, cases with hyperbilirubinaemia of not immune-haemolytic aetiology

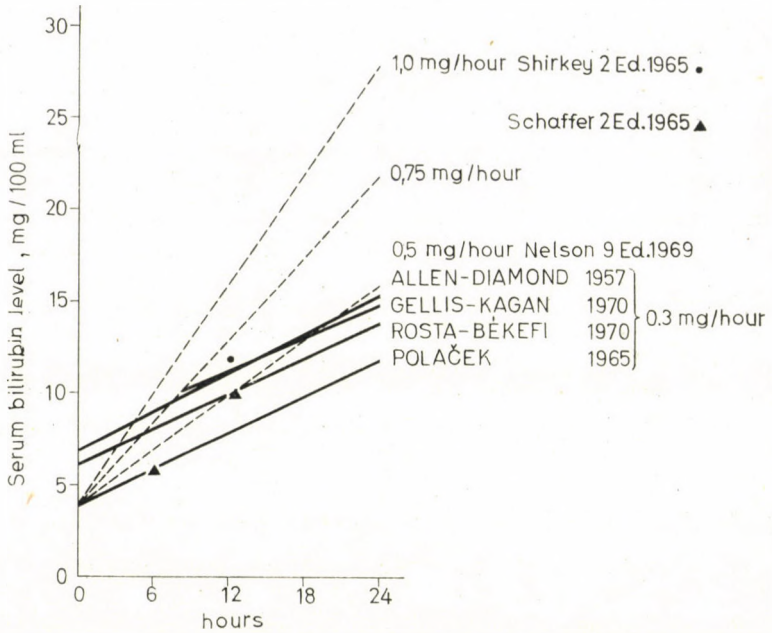

FIG. 1. Guide-lines and limit values for ndicating an exchange transfusion during the first 48 hours of life. Data collected from the pertinent literature. The absurdity of the 1.0 or 0.75 mg/hour rule is evident. Most authors, including the present ones, are working along guide-lines, accepting as an indication a more than 0.3/100 ml/hr rise in the pigment level

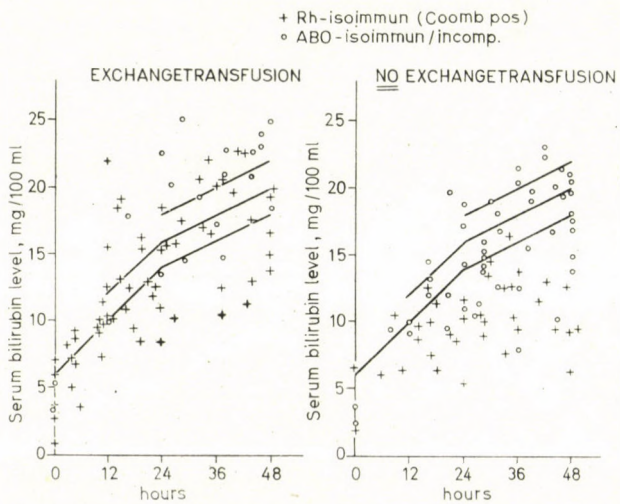

FIG. 2. Bilirubin levels in cases of Rh and ABO isoimmunization during the last five years. The decisive role of the values expressed by the lowest line for Rh and the medium and/or upper line for ABO isoimmunization is clearly seen

are growing in number, hence factors influencing glucuronization and maturity expressed in body weight and gestational age have increasingly to be considered. In this period the aim of the blood exchange is to prevent bilirubin encephalopathy and the success of an adequate indication may be estimated at follow-up examinations. Unfortunately, there is still no sufficient evidence to decide which pigment levels and under what clinical circumstances are deleterious to the central nervous system.

It is rather of historical interest to remember that the "magic" 20 mg/100 ml indication level was based on an early observation of HSIA et al. [7], where 18% of 50 babies with a pigment level between 16 and 30 mg per 100 ml developed a kernicterus.

Though the 20 mg/100 ml serum bilirubin level remained and has been accepted also by us as a safe limit for avoiding brain damage in Rh haemolytic disease, recent studies do not content themselves with such a superficial grouping of bilirubinaemias, as HSIA et al. did.

To reach a decision on the tolerated pigment level in cases of non-isoimmunized hyperbilirubinaemia, is a complicated question. Suggestions vary from performing an exchange transfusion at the ominous 20 mg level [18], irrespective of the aetiology, to not doing an intervention in such cases at all [21]. We cannot support either of these extreme views. Instead, we have constructed a new limit for otherwise healthy newborns with hyperbilirubinaemia, based on our recently completed follow-up study of children, 7—9 years after neonatal pathologic jaundice [17]. According to its results a bilirubinaemia surpassing a certain limit caused a significant 50% rise in the overall incidence of sequelae. We feel therefore justified in regarding this line as the highest tolerable level of indirect bilirubinaemia in healthy term infants.

A further advantage of our chart is the division of the between-zone limited by the two above described lines by a third one which allows for a more differentiated approach (Fig. 3).

Summarizing the three limit lines of our chart,

(i) the upper one refers to healthy term infants with a birth-weight of above 2700 g, when isoimmunization has been excluded;

(ii) the lowest one is to be applied in the case of isoimmunized babies with a positive Coombs-test, or infants about 2000 g birth-weight and/or newborns with signs of immaturity (less than 36 gestational weeks);

(iii) the medium line has been plotted for border-line cases respectively maturity (36—37 gestational weeks), a birth-weight between 2000 and 2700 g, and for cases where isoimmunization is slight or doubtful.

In cases of hypoxia, acidosis and other clinical signs heralding the development of bilirubin-encephalopathy, a one grade lower indication line has to be considered. In this context, archaic reflexes are of special interest; a lack of grasping or of Moro's reflex are by themselves menacing symptoms [15].

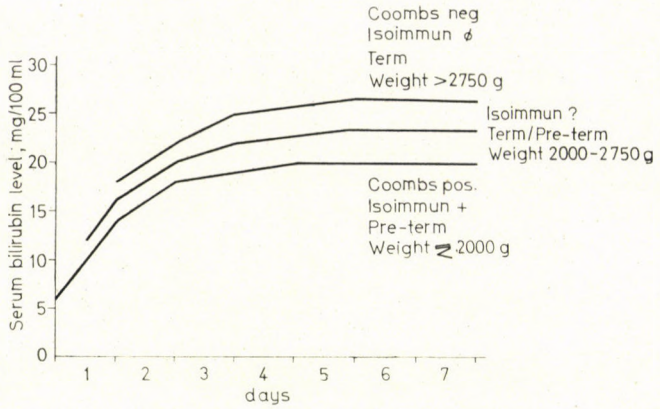

FIG. 3. New chart for indicating exchange transfusion in haemolytic disease of the newborn and neonatal hyperbilirubinaemia

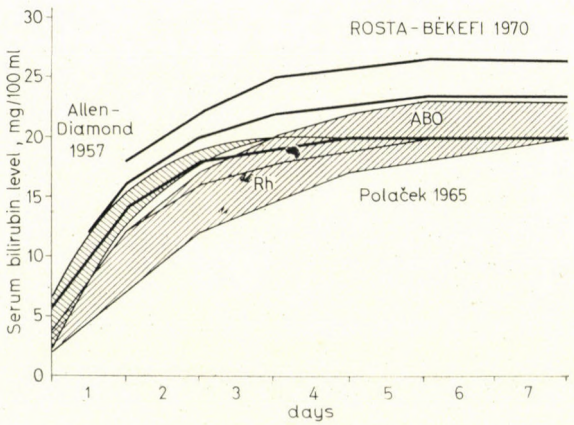

FIG. 4. Comparison of the new chart with those of ALLEN and DIAMOND and POLAČEK

Several recent studies have called special attention to jaundiced babies with a very low birth weight. Our chart does not apply to these infants who have to be treated on individual terms. Some of them must already be subjected to an exchange transfusion at a 12—14 mg/100 ml serum bilirubin level [1, 6, 19].

It is evident that our chart, in comparison with some earlier ones, allows more freedom to speculation and individual management and to judging as many factors as possible which may have a role in the development of kernicterus (Fig. 4).

On the other hand, some further components of the mechanism of pathologic neonatal jaundice such as genetic ones or the ratio of free albumin-binding sites would deserve an equal attention [11]. In a single diagram it is impossible to consider so many factors, but perhaps the computers will offer us assistance in this field in the not too distant future.

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