

## DERMAL ICTERIC ZONES AND SERUM BILIRUBIN LEVELS IN NEONATAL JAUNDICE

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### SYNOPSIS

A study of 60 oriental newborns with jaundice showed that racial pigmentation did not interfere with appreciation of dermal icterus. This study also confirms the findings of Kramer that progressive hyperbilirubinaemia in newborn infants is accompanied by a cranial-caudal advancement of dermal icterus. This reliable and convenient clinical technique for the estimation of serum bilirubin concentrations in neonatal jaundice provides valuable assistance to health personnel working in areas of the world where laboratory facilities are not readily available.

### INTRODUCTION

The prevention of kernicterus is dependent upon the early recognition of neonatal jaundice and its severity. However, laboratory facilities for the determination of serum bilirubin are not readily available in situations such as private medical clinics and rural health centres. There is a need for a convenient and reliable clinical method for the estimation of serum bilirubin levels in jaundiced newborns.

The icterometer has been used in an attempt to correlate intensity of jaundice with serum bilirubin concentrations (Gosset, 1960; Morrison and Wilkinson, 1962) but it is generally regarded as unreliable (Lucey, 1960; Zuelzer and Brown, 1961; Brown, 1962). Kramer (1969) revived the observation of Rolleston and McNee (1929) that progressive hyperbilirubinaemia in newborn infants is accompanied by a cranial-caudal advancement of dermal icterus, and showed a good correlation between dermal icteric zones and serum bilirubin concentrations. The present studies were performed to assess the applicability of the Kramer technique to Oriental populations where the racial pigmentation may interfere with appreciation of dermal icterus.

### PATIENTS AND METHODS

The study population consisted of 60 infants with neonatal jaundice born or admitted to the University Hospital, Kuala Lumpur, over a 6-week period in 1975. Forty-four were males and 16 were females. There were 12 Malays, 37 Chinese, 1 Orang Asli and 10 Indians. Their birth weights ranged from 1,460 gms to 3,990 gms, with a mean of 2,704 gms. Thirty-nine weighed more than 2,500 gms and 21 weighed 2,500 gms or less. Three infants had glucose-6-dehydrogenase deficiency, 3 had sepsis and 1 had

Rhesus incompatibility as the cause of their jaundice. The rest had either physiologic or idiopathic neonatal jaundice.

The evaluation of dermal icterus was carried out under daylight or blue-white fluorescent lighting by at least two observers. Under this lighting, the colour of bilirubin could be differentiated from racial pigmentation by its shiny and brighter hue. The most distal progression of dermal icterus was determined by blanching the skin with both thumbs and noting the colour of the underlying skin, and placed arbitrarily into 4 dermal zones (Fig. 1): Zone I (Face), Zone II (Neck to umbilicus), Zone III (Umbilicus to ankle) and Zone IV (Feet). Blood was obtained simultaneously for the determination of total serum bilirubin concentrations by a colorimetric technique (Malloy and Evelyn, 1937).

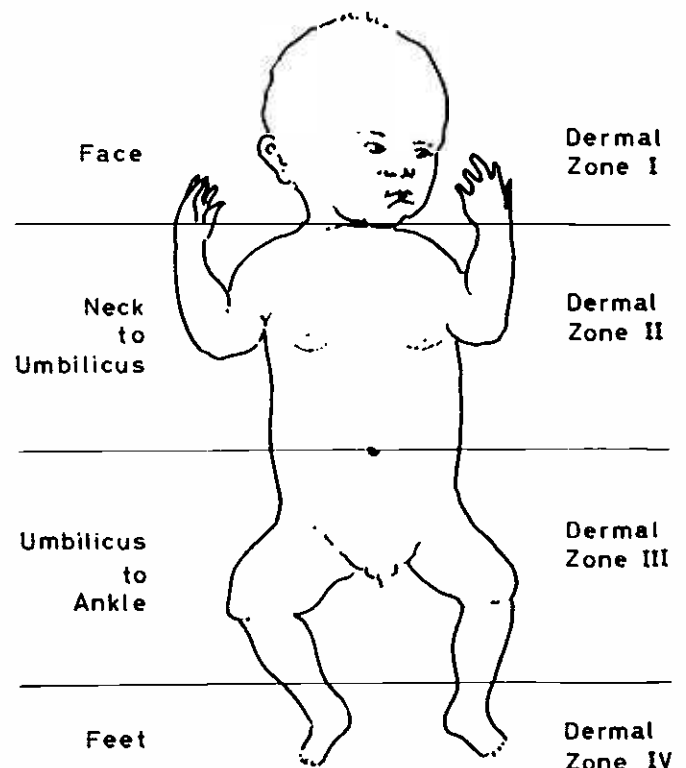


Fig. 1. Dermal Icteric Zones in Neonatal Jaundice.

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TABLE I  
CORRELATION BETWEEN DERMAL ICTERIC ZONES AND SERUM  
BILIRUBIN CONCENTRATIONS IN 60 INFANTS WITH  
NEONATAL JAUNDICE

Dermal zone	No. of infants	Total serum bilirubin (mg%)	
		Range	Mean $\pm$ S.D.
I Face	33	6.0—12.0	9.2 $\pm$ 1.5
II Neck to umbilicus	14	9.6—13.2	11.9 $\pm$ 1.6
III Umbilicus to ankle	8	12.6—18.0	15.4 $\pm$ 2.0
IV Feet	5	21.0—34.3	27.9 $\pm$ 5.0

## RESULTS

The correlation between dermal icteric zones and serum bilirubin concentrations in 60 infants is presented in Table I. The serum bilirubin concentrations (mean  $\pm$  S.D.) was 9.2  $\pm$  1.5 mg% in 33 infants with icterus confined to dermal Zone I, 11.9  $\pm$  1.6 mg% in 14 infants belonging to dermal Zone II, 15.4  $\pm$  2.0 mg% in 8 infants belonging to dermal Zone III, and 27.9  $\pm$  5.0 mg% in 5 infants with jaundice affecting dermal Zone IV. The difference between dermal Zones I and III, and dermal Zones III and IV were statistically significant ( $t = 2.05$ ,  $p < 0.05$ ;  $t = 3.9$ ,  $p < 0.01$ ; respectively). However, the difference between dermal Zones I and II, and dermal Zones II and III were not statistically significant. Since dermal icteric zones were arbitrarily defined, some degree of overlap between contiguous zones is to be expected.

## DISCUSSION

The results of the present studies confirm the findings of Kramer that the level of the most distal progression of jaundice corresponds predictably to the serum bilirubin concentration of newborns with jaundice. The reason for the phenomenon that progressive hyperbilirubinaemia leads to a cranial-caudal advancement of bilirubin deposition in the skin remains unclear. However, this phenomenon is not an isolated event in nature; some diseases have peculiar dermatologic presentations selectively affecting areas of skin, such as many viral exanthema, Henoch-Schoenlein purpura, or the rashes of auto-immune diseases.

The present studies show that racial pigmentation does not interfere with the interpretation of dermal icteric zones, if trained observers are employed to distinguish the shiny and brighter hue of bilirubin pigment. The Kramer technique is a reliable and convenient clinical method for the estimation of serum bilirubin concentration. It would be of great assistance to health personnel involved in the care of newborns in areas of the world where laboratory facilities for determination of serum bilirubin are not readily available. It would serve as a useful guide for referral of jaundiced infants to hospitals for fur-

ther management. Our findings indicate that involvement of dermal Zone III requires further investigations and close observation, whilst involvement of dermal Zone IV requires immediate therapeutic intervention. The Kramer technique is particularly useful in this population where neonatal jaundice occurs with greater frequency, in part due to the higher incidence of G. 6-P.D. deficiency.

In the experience of both Kramer and ourselves, the correlation between serum bilirubin concentration and dermal icterus may not hold under the following circumstances:

1. In severe Rhesus incompatibility when the serum bilirubin rises by more than 1 mg% per hour, skin deposition of bilirubin may lag.
2. During recovery when serum bilirubin is subsiding, the dermal jaundice does not recede in a caudal-cranial direction, but in a patchy manner.
3. Phototherapy interferes with assessment of dermal icterus due to photo-decomposition of bilirubin in the skin.

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