Serum creatine phosphokinase in normal newborns

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Gilboa, N., and Swanson, J. R. (1976). *Archives of Disease in Childhood*, **51**, 283. **Serum creatine phosphokinase in normal newborns.** Serum creatine phosphokinase (CPK) activity in 70 normal newborns was found to be significantly higher than the normal values found in adults or older children, and in some cases reached a level up to 10 times normal. It declined to near normal activity during the first 4 days and to normal level of activity by age 6–10 weeks. No clear correlation between birth trauma and increase in serum CPK activity was shown. CPK activity in cord blood was lower than in venous and capillary blood. Because of the increased CPK activity found in normal newborns, screening for Duchenne-type muscular dystrophy should be postponed for a few weeks after delivery.

Scarcity of data on serum creatine phosphokinase (CPK) activity in normal newborns, the different laboratory methods used in previously published studies, and the possibility of using the serum CPK activity in newborn screening for Duchenne muscular dystrophy (Zellweger and Antonik, 1975) prompted this study of CPK activity in 70 normal newborns.

Materials and methods

Blood was obtained from 70 normal newborns selected at random, at ages varying from 10 minutes to 10 weeks. The blood was obtained from three sources (1) umbilical cord blood immediately after severing of the cord; (2) venous blood obtained from antecubital fossa or dorsum of a hand; and (3) capillary blood obtained by heelprick. All blood samples, except for a few obtained from the umbilical cord, were examined within 12 hours. Muscle trauma during blood drawing was avoided as far as possible. Serial capillary blood samples were obtained from 27 babies. Capillary and venous blood were obtained simultaneously from 17 babies, and cord and capillary blood were obtained simultaneously from 24 newborns. The CPK activity in babies delivered vaginally, by elective caesarean section (CS) and by emergency CS, was compared.

CPK was assayed at 30°C according to the method of Rosalki (1967), with a centrifugal analyser (Centrif-Chem) and Boehringer Mannheim reagent kits (UV system CPK, Cat. no. 15790). The 15 µl specimens were diluted 1:27·7 in the reaction mixture. The activity was calculated from the absorbance change occurring between 6 and 8 minutes after starting the

reaction. The adult normal range of CPK activity according to this method is 0–75 IU/l

Results

CPK values were raised, compared to the normal range of CPK for adults and older children, in all but 4 newborns from whom only umbilical cord blood was obtained. Two or more serial capillary blood samples were obtained from 27 babies at ages varying from 1 day to 10 weeks. CPK activity was highest during the first 24 hours after delivery, with a gradual decline during the following 3 days (Fig. 1). 10 newborns who had raised CPK activity in capillary blood (mean 371 IU/l; range 170–803) during the first 4 days after birth showed values within the normal adult range at 6 to 10 weeks.

Assuming that birth trauma may be responsible, at least partially, for the raised CPK activity in newborns, we examined the effect of route of delivery on serum CPK activity during the first 24 hours after delivery (Fig. 2). The mean CPK activity in cord blood was surprisingly higher ($P=0\cdot02$) in babies delivered by elective CS than in those delivered vaginally. On the other hand, it was higher ($P=0\cdot015$) in the capillary blood in babies delivered vaginally compared to those delivered by elective CS. Though the venous CPK activity in babies delivered by elective CS was higher than in those delivered vaginally, the number of babies examined was not adequate for statistical analysis. CPK activity in cord blood in babies delivered by emergency CS was intermediate when compared to

FIG. 1.—Decline of capillary blood CPK activity with age in 27 newborns. Values expressed as mean $\pm$ SD.

FIG. 2.—Effect of route of delivery on CPK activity (mean $\pm$ SD) during the first 24 hours after birth. $\circ$ umbilical cord blood; $\triangle$ venous blood; $\bullet$ capillary blood; * range.

other routes of delivery, but the number of babies examined was again insufficient for statistical analysis.

These findings showed a direct correlation between capillary CPK activity and birth trauma, and an inverse correlation between cord blood CPK activity and birth trauma, assuming that babies delivered vaginally endure greater birth trauma than those delivered by elective CS. To evaluate the effect of the duration of labour on the CPK activity, the newborns were divided into 2 groups: those born after second stage of labour ≤ 1 hour, and those born after second stage > 1 hour (Table I). The mean CPK activity was higher in cord and capillary blood but lower in venous blood in babies born after prolonged second stage of labour. These differences were not significant ($P > 0.1$).

TABLE I

Effect of duration of second stage of labour on mean CPK activity

Duration of 2nd stage of labour	Cord blood	Venous blood	Capillary blood
≤ 1 h			
No. of babies	16	4	14
Mean $\pm$ SD	86.5 $\pm$ 30	323.5 $\pm$ 298	276 $\pm$ 180
Range	51-167	170-770	161-803
> 1 h			
No. of babies	9	3	6
Mean $\pm$ SD	94.5 $\pm$ 49	272 $\pm$ 0	344 $\pm$ 90
Range	11-167	245-314	207-441

In order to examine the possibility that there may be significant differences in serum CPK activity in cord, venous, and capillary blood, we simultaneously obtained cord and capillary blood from 24 newborns and capillary and venous blood samples from 17 newborns. The results clearly showed that the mean CPK activity was lower in cord blood than in simultaneously obtained capillary blood ($P < 0.001$) (Table II). The mean capillary CPK activity was 14.6% lower than the mean venous CPK, but this difference between capillary and venous blood was not significant ($P > 0.1$) (Table III).

TABLE II

Mean CPK activity in cord and capillary blood obtained simultaneously from 24 newborns

	Cord blood	Capillary blood
Mean $\pm$ SD	119 $\pm$ 71	263 $\pm$ 154
Range	51-247	118-803

TABLE III

Mean CPK activity in simultaneously obtained venous and capillary blood from 17 newborns

	Venous blood	Capillary blood
Mean $\pm$ SD	247 $\pm$ 199	211 $\pm$ 156
Range	58-795	56-803

Discussion

The role of serum CPK in diagnosis and screening of newborns for Duchenne-type muscular dystrophy (Zellweger and Antonik, 1975) makes the determination of its normal range in newborns very important. Among the few published studies on CPK in newborns are those of Rudolph and Gross (1966), Demos (1971), and Bodensteiner and Zellweger (1971). Our study confirmed the findings of other authors by showing highly increased CPK activity during the first few days after delivery. This increased activity was explained by the physical stress experienced by the fetus during the birth process (Rudolph and Gross, 1966; Bodensteiner and Zellweger, 1971). Contrary to Bodensteiner and Zellweger (1971), we found that the mean CPK activity was higher in cord blood of babies delivered by elective caesarean section than in those delivered vaginally. On the other hand, in agreement with Bodensteiner and Zellweger (1971) the mean capillary blood CPK was higher in babies delivered vaginally. The reason for this difference between cord and capillary CPK activity in relation to route of delivery remains to be explained. We, like Rudolph and Gross (1966), found higher CPK activity in cord and capillary blood with prolonged labour but in neither study was the difference significant. Thus, no clear correlation between birth trauma and serum CPK activity was established.

The comparison of CPK activity in cord, venous, and capillary blood showed a lower level of activity in cord blood compared to venous or capillary

blood. Bodensteiner and Zellweger (1970) showed that in normal adults the CPK activity in capillary blood is lower than in the venous blood and that the difference is constant. Contrary to these findings, our results showed that the difference between capillary and venous blood CPK activity is neither significant nor constant.

As suggested by Zellweger and Antonik (1975), screening of newborns for Duchenne muscular dystrophy has several advantages, including diagnosis of the disease in boys born to known carriers, diagnosis of new mutations, diagnosis of carriers, genetic counseling, and initiation of early supportive therapy. Our findings showed marked variability and increase in serum CPK activity in normal newborns, sometimes up to 10 times normal adult levels, during the first several days after birth. To render screening for muscular dystrophy more reliable, CPK assay should be postponed beyond the immediate neonatal period.

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