Systolic time intervals in anemic children with or without congestive heart failure


Systolic time intervals (STIs) were measured from simultaneous high speed recordings of electrocardiogram, phonocardiogram, and carotid artery trace in 47 children of anemia with or without congestive heart failure (CHF), and in 20 healthy normal children. Group I comprised 20 healthy controls with a mean Hb level of 13.65±0.73 gm percent, group II of 37 anemic children with a mean Hb level of 7.3±1.01 gm percent, without any evidence of CHF: Group III of 10 severely anaemic children with a mean Hb level of 2.75±0.82 gm percent with overt CHF. Electromechanical systole (QS2) pre-ejection period (PEP), left ventricular ejection time (LVET) and the ratio of PEP/LVET were studied and compared in various groups. PEP/LVET ratio was found to be 0.265±0.04, 0.363±0.07 and 0.407±0.06 in groups I, II, III cases respectively. The mean PEP/LVET ratio was significantly prolonged in groups II and III when compared with group I (p<.001). Further mean PEP/LVET ratio was significantly greater in group III subjects when compared with group II patients (p<.001). Thus it seems that LV dysfunction sets in early in cases of anemic children and as the severity of anemia increases, left ventricular dysfunction proportionately increases, ultimately resulting in congestive heart failure.

Key words: Anemia; congestive heart failure; systolic time intervals.

Systolic time intervals (STIs), as measures of left ventricular performance, have been widely used.1-3 Alterations in these intervals have been demonstrated not only in heart failure,3 but also in certain diseases like diabetes mellitus,4 chronic alcoholism,5 and chronic severely anaemic adults6,7 even without clinical evidence of heart failure. Left ventricular functions have been studied by this method in anemic adults with congestive heart failure.1,8,9 However, to the best of our knowledge the pediatric age group with anemia has not been explored by any worker so far. Since STIs is a simple, non-invasive procedure to analyse left ventricular functions, it becomes one of the ideal techniques in children.2 We have therefore undertaken this subject to demonstrate the effect of anemia on left ventricular functions in children with or without, overt congestive heart failure (CHF).

Material and Methods

A total of 67 children of less than 12 years of age were analysed for the present study. Amongst them 20 were normal and healthy children, and the remaining 47 were patients of anemia of various etiologies and duration. The diagnosis of anemia was
established in accordance with WHO criteria (1972). All cases were divided into three groups: Group I consisted of 20 normal, healthy, age and sex matched controls; Group II of anemic children without any evidence of congestive heart failure and Group III of patients of severe anemia (Hb less than 3 gm%) with congestive heart failure.

All cases underwent a complete clinical examination to rule out evidences of any other disease known to alter SIIs values. The SIIs were measured from a simultaneous recording of the electrocardiogram, phonocardiogram, and carotid artery pulse tracing on a multichannel direct recording machine (E for M) at a paper speed of 100 mm per second and a sweep of 10 consecutive complexes were recorded and their mean was taken. The recordings were taken in the basal post absorptive state between 9 and 11 A.M. All patients had a normal heart size on chest X-Ray film, except those in Group III who had cardiomegaly. None had any evidence of atrioventricular or intraventricular conduction defects. All cases were in sinus rhythm. The electrocardiographic Lead II was used since this showed the onset of ventricular depolarization clearly in all cases. The phonocardiogram was recorded with a piezo electric crystal microphone over the precordium in a position optimal for recording the first high frequency vibrations of the second heart sound.

The carotid arterial pulse tracing was recorded from the right carotid artery in held expiration, the recording being taken only when the carotid notch was clearly evident. The following intervals were then measured:

i) Total electromechanical systolic interval (QS2)—from the onset of the Q-wave to the first high frequency vibrations of the second heart sound; ii) The left ventricular ejection time (LVET)—from the beginning of the upstroke of carotid pulse to the trough of the incisura; iii) The pre-ejection period (PEP) was calculated by subtracting the LVET from QS2; iv) The ratio of PEP/LVET was calculated from the above values; v) The RR intervals, for heart rate; and vi) QS2, LVET & PEP were corrected for heart rate using the regression equation of Weissler et al and the Suffix (C) identifies these derived indices as QS2C, LVETC and PEPC respectively.

Results

Group I cases (control group) consisted of 20 healthy children (13 males and 7 females). Their mean Hb level was 13.65 gm percent (range 12.5-15 gm%) and their mean age was 7.90 years (range 3-12 yr). There were 37 patients (30 males and 7 females) in group II (anemic children without CHF) with mean Hb level of 7.3 gm percent (range 3.1-10.5 gm%) and mean age of 7.58 years (range 3-12 yr). In group III, comprising 10 severely anemic children (6 males and 4 females) with congestive heart failure, the mean Hb level was 2.75 gm percent (range 2-3 gm%) and mean age was 7.66 years (range 3-12 yr).

The QS2C, PEPC, LVETC & PEP/LVET ratio of various groups is shown in Table-1. The mean QS2C, PEPC and PEP/LVET ratio were significantly elevated (p<.001) in group II patients when compared with group I (controls). Similarly, these values showed significant elevation (p<.001) in group III patients when compared with group II. This signified that as the severity of anemia increased, the values of mean QS2C, PEPC & PEP/LVET ratio also increased proportionately (Table).

The mean LVETC values, however, did not vary significantly in various groups of patients.