Normal size of liver in infancy and childhood

X-ray study

D. DELIGEORGIS, D. YANNAKOS, and S. DOXIADIS

From the Institute of Child Health and the Radiology Department of the 'Aghia Sophia' Children's Hospital, Athens, Greece

Deligeorgis, D., Yannakos, D., and Doxiadis, S. (1973). *Archives of Disease in Childhood*, 48, 790. **Normal size of liver in infancy and childhood: x-ray study.** The longest vertical distance between the upper and lower borders of the liver measured radiologically is suggested for estimating the size of the liver. This parameter, called vertical axis of the liver, was measured in 350 healthy infants and children, and the normal range at different age groups was defined. There was no correlation between palpability of the lower border and vertical axis, which shows that both parameters of the size of the liver depend on the position of the organ, apart from the size.

Estimation of the vertical axis is suggested as a complementary measurement for cases where the palpability of the lower border of the liver gives values in the upper normal limits but where there are other reasons to suspect that the liver is enlarged.

A frequent question in paediatric practice is whether the liver is normal or enlarged. To answer this we decided to study the normal size of the liver using a variety of methods.

In the first part of our study (Deligeorgis *et al.*, 1970) we defined the upper and lower borders of the liver in 350 healthy children, between birth and 16 years, by percussion and palpation. It was found that in the supine position and at the end of expiration the liver may project below the costal margin as much as 3.5 cm, the projection decreasing with age. In a considerable number of infants the liver edge projects 3.0 to 3.5 cm, while in children 10 to 16 years of age the liver edge usually projects no more than 1 cm. The upper border may be anywhere between the 4th and 6th intercostal spaces.

In the present analysis the normal range of another parameter of the size of the liver has been studied. This is the longest vertical distance between the upper and lower borders of the liver as measured on x-ray film. We call this parameter the vertical axis of the liver.

Material and methods

The vertical axis of the liver was measured in the same infants and children in whom we estimated the upper and lower borders of the liver by percussion and

FIG. 1.—Measurement of vertical axis of the liver by x-ray. The lower horizontal line is drawn from the lowest right border of the liver.

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FIG. 2.—Vertical axis of the liver related to weight.

FIG. 3.—Vertical axis of the liver related to height.

FIG. 4.—Vertical axis of the liver related to age.

palpation. X-ray of the liver was taken* with the child lying supine without a pillow, with the lower extremities extended and the upper extremities parallel to the body. The x-ray method used was the one suggested by Doxiadis and Stergiou (1964). The x-ray tube was placed above the child perpendicular to the liver area and at a distance of 140 cm from the film. By this method it was easy to define on the film the upper and lower borders of the liver. A horizontal line was drawn across the uppermost region of the liver, just below the dome of the diaphragm, and another line was drawn parallel to the first across the lowest right border of the liver. The vertical distance of the two lines in cm is the vertical axis of the liver (Fig. 1).

Results

Fig. 2, 3, and 4 show the relation of the vertical axis of the liver to weight, height, and age, respectively. It can be seen that the vertical axis of the liver increases with weight, height, and age.

Fig. 5 shows the average values and SD of the vertical axis of the liver at different age groups.

There was no correlation between the values of the vertical axis of the liver and those found by palpation in the first part of our study. In the same

FIG. 5.—Average values and SD of vertical axis of the liver in various age groups.

*With regard to ethical considerations, the authors have informed us that the x-rays were not taken primarily for research purposes, but were part of a regular clinical and laboratory check made on children in a residential nursery and in a residential school. *Editors.*

age group, children whose liver projected more below the right costal margin did not have the longest vertical axis.

Discussion

The first part of our study defined the normal borders of the liver in infancy and childhood by clinical examination. The normal range of projection of the liver edge below the costal margin appeared considerably wide (0 to 3.5 cm for infants and 0 to 2 cm for older children). It seemed possible, therefore, that some children with enlarged livers could appear with a liver edge projection within the normal limits. In an attempt to solve this problem we measured radiologically the vertical axis as another parameter of the size of the liver. It is interesting that there was no correlation between palpability of the lower border and the vertical axis. It appears that both parameters depend, apart from

the size, on the position of this organ. The vertical axis of the liver can therefore be used as a complementary measurement when the palpability of the lower border is in the upper limits of normal, and when there are other reasons to suspect that the liver is enlarged. In these cases, if the vertical axis is found within normal limits, the liver size could be considered as normal, but if the vertical axis is increased, then the liver is probably enlarged.

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Correspondence to Dr. D. Deligeorgis, Institute of Child Health, Aghia Sophia Children's Hospital, Athens 608, Greece.