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Liver size: Comparing Sonography and the Traditional Method
in Infancy and Early Childhood

Background / Objective: A sound measurement of the liver size in children of different age groups is necessary to help the pediatrician exclude hepatomegaly. In addition to the traditional methods, we decided to obtain an adequately reliable "nomogram" of the liver size in the pediatric population.

Patients and Methods: This applied prospective cross-sectional study included 180 healthy children (boys and girls equally), aged 1 month up to 6 years, whose families resided in West Tehran. A parental consent was obtained. The children were divided in 6 different age groups of equal size: 1-3, 4-6 , 7-12 months; and 1-2, 2-4, and 4-6 years First, the children's height, weight and liver span (by percussion/palpation and percussion method) were measured. Then, the hepatic length (M.C.L.) and antero-posterior dimension were obtained by Real-time Ultrasound.

Results: There was a close correlation coefficient between liver dimensions and age, height, and body surface area, except sex. There was a 95% correlation coefficient between the liver span and size on sonography (M.C.L. and A.P). The body length had the strongest correlation of all other developmental variables.

Conclusion: We were able to record a Standard liver nomogram on Iranian children since 1 mo up to 6 years, and found that the M.C.L. was well correlated with liver span.

Keywords: Liver size, Nomogram, Sonography, Clinical method, infancy, childhood.

Introduction

The normal values for the liver size in children of different age groups are important and necessary in proving or excluding hepatomegaly. Since 1908,[14] reports on different methods from various places have yielded more or less different results. By this study, our purpose was to archive: a standard for normal liver size in healthy children of 1 month up to 6 years of age, and to assess the effectiveness of the widely used liver span measurement in estimation of the liver size.

Patients and methods

This prospective cross-sectional applied study involved 180 healthy children (boys and girls equally) aged 1 month to 6 years, who referred to primary health clinics and kindergartens in the areas supported by Iran University of Medical Sciences. The child's negative past history of significant illnesses, and a parental consent were required for inclusion in the study.

The children were divided into six different groups: 1-3 months, 4-6 months, 7-12 months, 1-2 years, 2-4 years, and 4-6 years, respectively. The height and weight of each child was recorded. The liver span was obtained by two well-trained third-year residents in Pediatrics by percussing the upper and lower liver borders along the M.C.L, while the child was lying supine with knees slightly flexed4. Liver sonography was performed at the same visit by the author who was blinded to the clinical result. The ultrasound device used in this study was a real-time scanner Eub 315 Hitachi with 3/5 MHz Sector transducer.

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The images were obtained while the child was lying supine, and the section level was along the M.C.L by simultaneous demonstration of the right kidney as reported by Dittrich2. The longitudinal dimension was also obtained from the upper margin of the liver (defined as the uppermost edge under the dome of the diaphragm) to the lower margin (defined as the lowermost edge of the right lobe.[1] (Figures 1 and 2)

The antero-posterior dimension measured from the upper most edge under the dome the diaphragm up to the surface which crossed the portal vein (Figure 3).

If the whole liver image could not be well demonstrated on the screening monitor, we would obtain images in two adjacent cuts for higher accuracy. The measurement from the uppermost dome of the diaphragm to the upper edge of the portal vein was add to the other line from the upper edge of the portal vein to the lower age of the liver (author) (Figure 4).

Results

The statistical results of the liver size by clinical estimation (the liver span) and by sonographic measurement of the longitudinal and antero-posterior dimensions are tabulated to the effective variables such as sex, height, weight, age and body surface area in Tables 1 and 2 respectively. No significant difference was found between the results of peer girls and boys of all the age groups.

As depicted in Table 3, a significant positive correlation (p-value = 0.001) was found between the height and the liver span (r = 0.915), M.C.L (r = 0.995) and AP (r = 0.881). As it is shown, the height has a stronger correlation with the first 2 (i.e liver span and M.C.L)

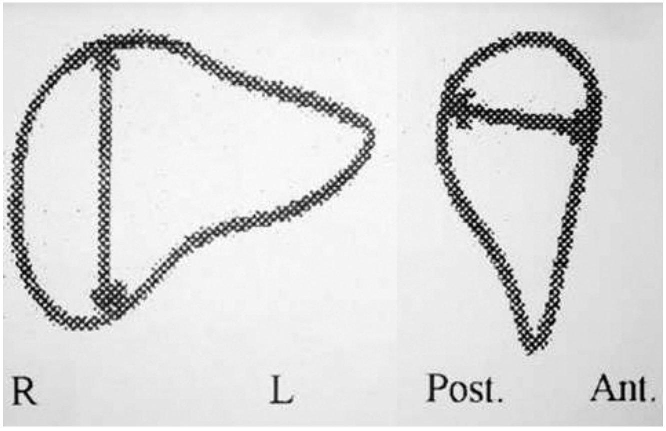

Figure 1: demonstrate how to measure M.C.L. and A.P diameters

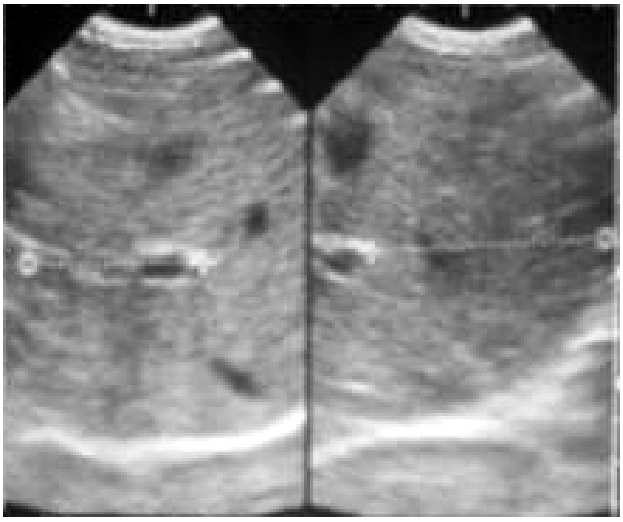

Figure3: demonstrate how to measure M.C.L in two cuts

Figure 2: demonstrate how to measure the M.C.L diameter

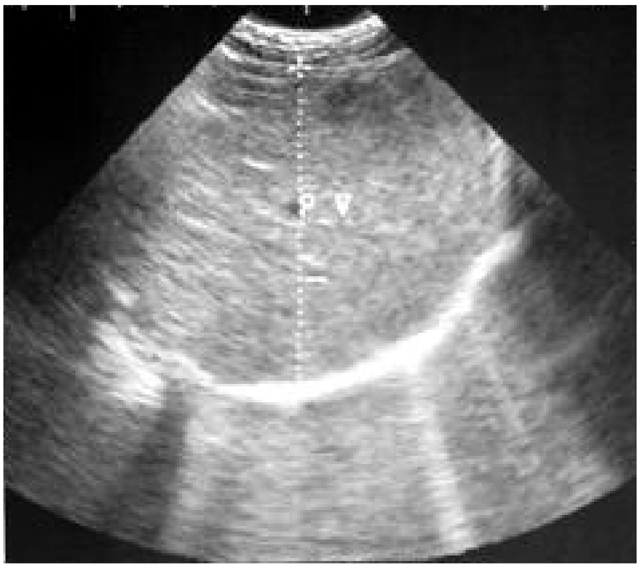

Figure 4: demonstrate how to measure A-P diameter

Table 1: Longitudinal dimension of the right lobe of the liver to age, height, weight and body surface area

Subjects						Longitudinal dimension of liver (M.C.L) mm				
Age month	No	Height Mean(cm)	S.d	Weight Mean(gr)	Sur Mean	Mean	Median	Mode	S.d	Normal range
1-3	30	55.56	4.96	4888	27.73	51	50	50	3.824	42-.57
4-6	31	62.29	3.86	6598	35.14	52.96	50	50	5.666	40-66
7-12	31	69.30	5.31	8675	42.51	56.61	57	60	6.243	45-68
13-24	28	77.53	6.75	10220	49.92	63.50	63	65	6.351	55-76
25-48	32	90.70	9.77	13633	64.70	73.59	72	70	7.774	58-91
49-72	28	112.71	6.64	18107	79	80.750	81	80	5.096	70-95

Table 2: Antero-posterior dimension of the right lobe of the liver to, age, height, weight and body surface

Subjects						A-P (mm)				
Age mo	No	Height Mean(cm)	S.D	Weight Mean(gr)	Sur Mean	Mean	Median	Mode	S.D	Normal range
1-3	30	55.56	4.96	4888	27.73	63.13	63	62	4.988	52-76
3-6	31	62.29	3.86	6598	35.14	67.96	68	72	6.998	50-82
7-12	31	69.03	5.31	8675	42.51	70.90	71	65	4.976	63-81
13-24	28	77.53	6.75	10220	44.92	82.78	84.5	85	6.951	70-94
25-48	32	97.70	9.77	13633	64.70	88.34	87.5	85	8.476	70-105
49-72	28	112.71	6.64	18107	79	95.92	96	97	5.178	85-107

Table 3: Demonstrate liver span from 6 mo to 6 years

Subject						SP(mm)				
Age mo	No	Height Mean(cm)	S.D	Weight Mean(gr)	Sur Mean	Mean	Median	Mode	S.D	Normal range
1-3	30	55.56	4.96	4888	27.73	49.53	50	50	2.345	40-55
4-6	31	62.29	3.86	6598	35.14	51.45	50	50	2.307	50-55
7-12	31	69.03	5.31	8675	42.51	54.77	55	50	5.018	45-60
13-24	28	77.53	6.75	10220	49.92	61.07	60	60	6.434	50-80
25-48	32	97.70	9.77	13633	64.70	71.188	70	70	6.907	60-90
48-72	28	112.71	6.64	18107	79	80.321	80	80	5.644	70-95

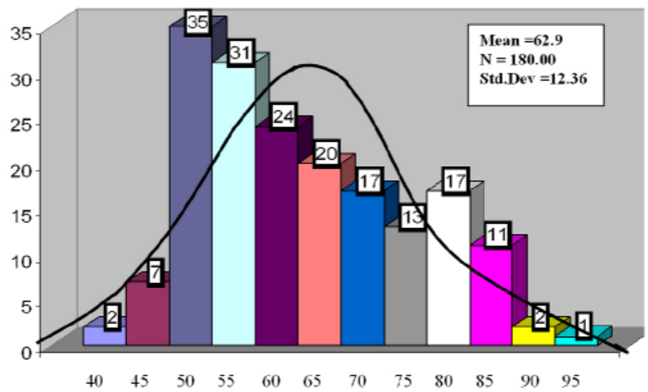

Figure 5: Distribution of the right liver lobe length (M.C.L) in the Age group of 1 month to 6 years.

The age was the second variable that correlated (C.C= 95%), with the liver span (r=0.912) M.CL(r=0.856) and A-P (r=0.845) dimensions. And also there is a good correlation between the liver span and sonographic liver measurements.

(M.CL & AP) r=0.94, r=0.84. 0.84 respectively.

Discussion

By reviewing the literature the history of clinical estimation of liver size in pediatric is trace back to 1908 by Cruchet & Serege 14. In 1970 Deligeorgis et al 15 examined liver size clinically and roentgenographically in 365 health infants and children. This study emphasized the importance of examining of both the upper and lower liver borders, but due to the radiation hazards was not accepted.

In 1975, Holder et al[7] measured the liver size in 185 children from 6 days to 18 years of age to exclude hepatomegaly by using linear probe in sagittal plane by both scintigraphy and sonography. The liver size was 4 cm smaller in sonography than scintigraphy due to the magnification technique in this study. The body length showed the best correlation with the size of the liver as compared to other body indexes. There was a correlation between sonography and scintigraphy 1.46 S.D. In 1982, Wiseman et al[6] examined 100 neonates with percussion of the upper border and palpation of the lower border. The liver span was reported 5.65 cm with 95% confidential interval. No correlation was found between weigh, height, sex or head circumference and the liver size. In 1983, Detrich[2] reported that the evaluation of liver size by percussion and palpation method was unreliable. He performed sonography as a fast, non invasive and more accurate method for liver and spleen size measurements with demonstration of anatomy and morphology of the liver in 794 children. He reported a correlation between liver size and the child's height as a reference parameter. In 1987 Markisz et al [3] examined 116 children doing volume measurement by scintigraphy and found a high correlation between the liver volume and patient weight and age. He found out that the organ size was larger by scintigraphy than sonography similar to Holder study.

In 1983 Chung min chen[4] evaluated liver size in 145 term & preterm neonate by clinical (percussion & percussion/palpation) and sonography. They found a correlation between clinical measurement (liver span) with that of the sonographic method and the mean liver span in the Chinese neonates was 1 cm smaller than the Western neonates

The last report is from Turkey by Oznur L et al 1998[1]. They reported organs measurement by sonography on 307 children aged 5 days up to 16 years. They considered the height was the best index to correlate with longitudinal dimension of liver. They suggested the normal range of liver was larger compare to that was previously reported [2,3,5,7]. They believed this was due to different techniques. In our study we used the same technique as Oznur L et al[1] using 3.5 sector probe and measuring the M.C.L. and antero-posterior dimensions of the liver (Figures1,2 and 3) but our normal range, and 50th – 95th percentile for M.C.L. and antero-posterior diameters of the liver are smaller than Oznur reports but (Table 1 and 2) more or less are similar to two other reports [7, 2, 3, 4].

In addition we used liver span too (by percussion and percussion / palpation) which well correlated with sonography (MCL & A-P) like reported by Ming Chen[4].

Considering the variables of age, height, weight, and body surface area; there were no statistical difference between our results of the longitudinal and antero-posterior dimension of right lobe in each group in and those of other reports.

A significant correlation was found between liver span and liver dimensions (M.C.L & A-P) with body parameters (Table 3) as shown the largest correlation with body parameters assigned to liver span. Among all the body parameters, the body height is slightly more correlated to the size of the liver.

Conclusion

We managed to record a standard liver nomogram on Iranian children 1 month to 6 years old, which is well correlated with the liver span. The liver length is well proportionate to body parameters especially the body length.

Acknowledgments

The authors would like to thank Dr. Poureslami for consultation and Dr. Bagher zadeh for statistical analysis.

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