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MEDIASTINAL LYMPH NODES IN HEALTHY CHILDREN; FREQUENCY, SIZE RANGE AND DISTRIBUTION BY AGE

SAĞLIKLI ÇOCUKLARDA MEDİASTİNAL LENF GANGLİONLARI; YAŞA GÖRE SIKLIK, BOYUT ARALIĞI VE DAĞILIM

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ABSTRACT

Objective: Decision making about clinically significant lymph nodes (LN) is crucial. We elaborated the mediastinal LNs based on location, size and age groups.

Material and Method: Contrast enhanced chest computed tomography scans of 150 children who were referred to the radiology department after trauma, were evaluated retrospectively. All participants were divided into five age groups (0-24, 25-60, 61-120, 121-180 and 181-216 months) which included thirty children each. We documented the shortest and longest axis diameters of the largest LNs and their location along with the age and gender of the children. Kolmogorov-Smirnov test, t test, Spearman's correlation analysis assessment and descriptive statistics were expressed using SPSS 22.

Results: Mean ages were 11.53±10.1, 39.4±11.1, 84±15.9, 154.9±17.6, 190±9.3 months in consecutive age groups and 96±69.17 months in general. The most frequent locations with detectable LNs were subcarinal (n:98, 64%), right lower paratracheal (n:88, 57%), right tracheobronchial (n:82, 56%), right upper paratracheal (n:75, 49%) and left tracheobronchial (n:61, %39) lymphatic stations. Mean short and long axis diameters were 3.97±1mm (interquartile range:3.4-5.2) and 7.48±1.98mm (interquartile range:6.3-9.1) among detected 648 LNs, respectively. Both short and long axis diameters of LNs in low cervical, prevascular, subcarinal, right-left paratracheal and right-left tracheobronchial locations were correlated with the age ($p<0.05$). Both short and long axis diameters of subcarinal LNs (4.78±1.05mm, 9.30±1.8mm) were significantly larger than right lower paratracheal (4.03±0.9mm, 7.94±1.6mm; p:0.001), right tracheobronchial (4.42±1.26mm, 8.59±2.1mm; p:0.04) and right upper paratracheal LNs (3.64±0.79mm, 7.1±1.49mm).

Conclusion: Being aware of the size range for normal mediastinal LNs according to ages and locations would facilitate management and reduce unnecessary interventions and medications.

Keywords: Children, lymph node, mediastinum, computed tomography

ÖZET

Amaç: Klinik olarak anlamlı lenf nodları (LN) hakkında karar vermek çok önemlidir. Mediastinal LNları lokasyon, boyut ve yaş gruplarına göre değerlendirdik.

Gereç ve Yöntem: Travma sonrası radyoloji bölümüne yönlendirilen 150 çocuğun kontrastlı göğüs bilgisayarlı tomografi taramaları retrospektif olarak değerlendirildi. Tüm katılımcılar her biri otuz çocuğu içeren beş yaş grubuna ayrıldı (0-24, 25-60, 61-120, 121-180 ve 181-216 ay). En büyük LNlarının kısa ve uzun eksendeki çapları konumları, yaş ve cinsiyetlerine göre değerlendirildi. SPSS 22 programı ile Kolmogorov-Smirnov testi, t testi, Spearman korelasyon analizi ve tanımlayıcı istatistikler çalışıldı.

Bulgular: Ortalama yaş, gruplarda sırasıyla 11,53±10,1 ay, 39,4±11,1 ay, 84±15,9 ay, 154,9±17,6 ay, 190±9,3 ay ve toplamda 96±69,17 aydı. LN'larının en sık görüldüğü lokasyonlar subkarinal (n:98, %64), sağ alt paratrakeal (n:88, %57), sağ trakeobronşiyal (n:82, %56), sağ üst paratrakeal (n:75, %49) ve sol trakeobronşiyal (n:61, % 39) lenfatik istasyonlardı. Ortalama kısa ve uzun eksen çapları sırasıyla 647 LN arasında 3.97±1mm (çeyrekler arası aralık: 3,4-5,2) ve 7,48±1,98mm (çeyrekler arası aralık: 6,3-9,1) idi. Alt servikal, prevasküler, subkarinal, sağ-sol paratrakeal ve sağ-sol trakeobronşiyal lokasyonlarda LNlarının hem kısa hem de uzun eksen çapları yaşla korele idi ($p<0,05$). Subkarinal LN'larının kısa ve uzun eksen çapları (4,78±1,05 mm, 9,30±1,8mm) sağ alt paratrakeal (4,03±0,9mm, 7,94±1,6mm; p:0,001), sağ trakeobronşiyal (4,42±1,26mm, 8,59±2,1mm; p:0,04) ve sağ üst paratrakeal LN'lerden (3,64±0,79mm, 7.1±1,49mm) anlamlı derecede büyüktü.

Sonuç: Yaş ve yerleşime göre normal mediastinal LN'lerin boyut aralığının farkında olmak hasta yönetimi kolaylaştırır, gereksiz müdahaleleri ve ilaç kullanımını azaltır.

Anahtar Kelimeler: Çocuklar, lenf bezi, mediasten, bilgisayarlı tomografi

This study was presented in ''Pediatri Günleri Congress (2019, İstanbul) as oral presentation and has been choosen for the best oral presentation award.

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INTRODUCTION

Assessment of the pediatric mediastinum is commonly performed by posteroanterior chest roentgenograms. There are several anatomical structures in healthy children contributing to mediastinal wideness such as thymus, great vessels, and sternum. Normal mediastinal lymph nodes (LNs) do not cause deterioration or thickening of mediastinal lines on posteroanterior chest roentgenograms since they are obscured by major vessels and bones. Lateral chest roentgenogram provides partial elimination of superposition of vessels and LNs on posteroanterior chest roentgenograms and clearly demonstrates the paratracheal regions and pulmonary hilum. Lateral chest radiographs have been suggested for detection of any lymphadenopathy which it is accepted as the major sign for diagnosing pulmonary tuberculosis in children (1). It has been suggested that no oval or spheric soft tissue density consistent with lymphadenomegaly are demonstrated around dorsal or inferior to the lower trachea (near the carina) and bronchus intermedius on lateral chest roentgenograms in normal children (2). Evaluation of plain chest radiographs and final decision have been variable among clinicians especially in detecting tuberculous lymphadenopathy (3). Recurrent lymphadenopathy, background lymphoreticular malignancy and additional symptoms such as weight loss and fever with unknown origin or a suspician of a specific infection such as tuberculosis even if the pulmonary parenchyma is normal, should direct healthcare professionals to a further investigation of LNs with an advanced imaging modality such as computed tomography (CT). An initial PET (Positron Emission Tomography) - CT examination is required to be performed in children with lymphoreticular system malignancy which are mostly seen in the first decade (4). Decision making in children with incidental LNs or refractor lymphadenomegaly is critical either in cases of atypical infections or in suspected cases of neoplasia. In routine practice, even if the causative agent cannot be proven, in cases of suspected tuberculous lymphadenitis, the decision making process between prophylaxis and treatment dose for antituberculous therapy depends on the size and architecture of the LNs. However, the size and the distribution of the hilar and mediastinal LNs on the chest CT based on age have not been well established. The radiation exposure restricts the experiments especially in the pediatric age group. Nowadays, technological developments providing multidetector CT images with thinner slices and lower exposure doses make LNs more detectable than in the past. Therefore, revealing the intrathoracic distribution and size range of LNs in the healthy pediatric population according to ages will result in a reduction of unnecessary medications and interventions.

MATERIAL AND METHOD

Patients

A total of 150 pediatric patients (90 male and 60 female) admitted to the Emergency and Traumatology Department after a trauma and referred to the Radiology Department were included in this study. This study was approved by the İstanbul Faculty of Medicine Ethic Committee (ethics no. 2015 / 1738). We did not receive informed consent from the patients' parents because of the retrospective design, the indication of CT examination for trauma, and our inability to use any personal information. Intravenous contrast enhanced chest CT examinations were selected from the picture archive and communication systems between December 2010-December 2015. Patients who were under follow-up for a background malignancy or hospitalization for severe chest injury were excluded. The patients were divided into five groups, namely 0-24, 25-60, 61-120, 212-180 and 181-216 months, according to their ages when the CT examination was conducted.

Chest CT protocol

Chest CT images were obtained using 0.5 mm x 64 detector CT scanner (Aquillon 64, Toshiba Medical Systems, Tochigi, Japan). All images were obtained using intravenous contrast agent and the patients were in supine position. The chest CT images were obtained with a radiation exposure range according to age, height and mass of the patients. The exposure protocol was; 80-100 kVp up to 1 years, 75 cm and 10 kg; 80-100kVp up to 5 years, 110 cm and 19 kg, 100 -120kVp up to 10 years, 140 cm and 32 kg (in general 1mAs per kg). The CT images were assessed in both pulmonary parenchyma and mediastinum windows by two radiologist with at least five years experience in pediatric radiology. CT images associated with lymphadenopathy due to lung infections, pulmonary

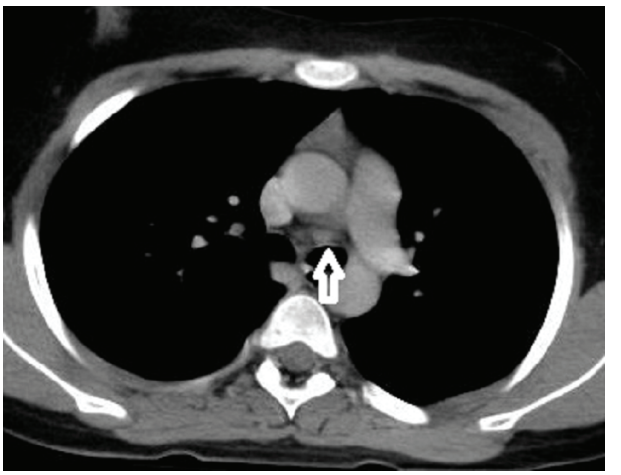

Figure 1a: Axial section of contrast enhanced chest CT reveals left lower paratracheal lymph node.

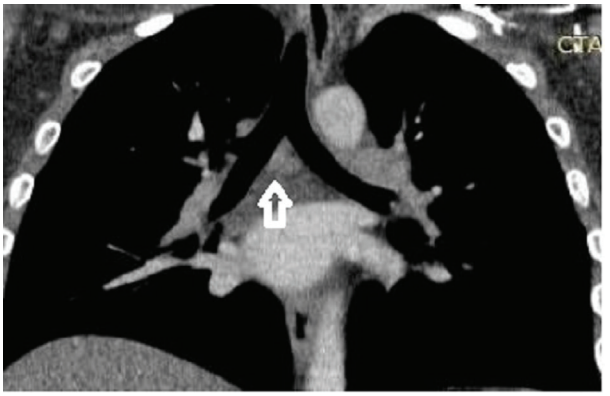

Figure 1b: Coronal section of contrast enhanced chest CT reveals subcarinal lymph node.

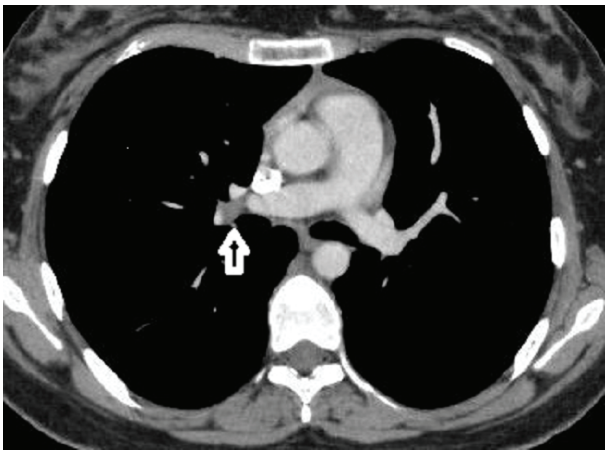

Figure 1c: Axial section of contrast enhanced chest CT reveals right tracheobronchial lymph node.

laceration or mediastinal hematoma were excluded. The mediastinal and hilar lymph node distributions were cathegorised as low cervical (LC), right upper paratracheal (R-UPT), left upper paratracheal (L-UPT), right (R-LPT) and left lower paratracheal (L-LPT), prevascular (PV), aorticopulmonary window (APW), paraaortic (PA), subcarinal (SC), right (R-TB) and left tracheobronchial (L-TB) (Figure 1 a,b,c). LNs according to the margins of the lymphatic stations described in American Thoracic Society Lymph Node Stations map (5). The presence of detectable LNs in each lymphatic station, and the short and long axis diameters of the largest LNs in each station were assessed on axial sections with coronal and sagittal reconstructions on a work station within the Radiology Department in Istanbul Medical Faculty.

Statistical analysis

SPSS 22 programme was used for statistical purposes. Descriptive statistics of the data were expressed as minimum, maximum, mean, standard deviation and median with interquartile range. Frequencies were expressed as percentages. Distributions of variables were tested by Kolmogorov-Smirnov test. Differences among mean diameters in each station and age group were compared with independent samples t test. Spearman correlation analysis was used in correlation analysis.

RESULTS

Sixty female (mean age: 92.7±68.87months) and ninety male patients (mean age: 98.05±69.86 months) were included in this study. No significant difference among mean ages was found among genders. Mean ages were 11.53±10.1months, 39.4±11.1 months, 84±15.9 months, 154.9±17.6 months, 190±9.3 months in age groups respectively and 96±69.17 months in total. Descriptive statistics of both short and long axis diameters of the largest LNs in each station were shown in Table 1 and 2. Median short axis diameter varies between 3.5mm to 5.3 mm among all participants and all lymphatic stations. Median long axis diameter varies between 6.6 mm to 9.5 mm among all participants and all lymphatic stations. Mean values of short and long axis diameters were 3.97±1 mm and 7.48±1.98 mm among the detected 648 LNs respectively. Mean short axis diameters were 3.36±0.59 mm, 3.66±0.8 mm, 3.94±0.82 mm, 4.87±1.34 mm, and 4.27±1.13 mm in age groups respectively. Mean short axis diameters were significantly different between the age groups (p: 0.001). Mean long axis diameters were 6.72±1.26 mm, 7.11±1.07 mm, 7.76 ±1.40 mm, 8.64±2.45 mm, 8.45±2.25 mm in age groups and the differences were statistically significant

Table 1: The mean ages and gender distribution of the participants in each group

	Age (months)	Gender	
Groups (months)	**Mean±Standard deviation**	**Female**	**Male**
1 (0-24)	11.53±10.1	11	19
2 (25-60)	39.4±11.1	14	16
3 (61-120)	84±15.9	11	19
4 (121-180)	154.9±17.6	12	18
5 (181-216)	190±9.3	12	18
Total	96±69	60	90

between the age groups (p:0.001). LN detection ratios in each station based on age groups were shown in Table 3. Commonly encountered LNs were found to be R-TB (56% in general; 83% in group 5), SC (64% in general; 80% in group 5), R-LPT (57% in general; 70 % in group 1), R-UPT (49% in general; 63 % in group 1) and L-TB (63% in group 5) stations. When we compare the long and short axis diameters of commonly encountered lymphatic stations, mean short axis (4.4±1.26 mm) and long axis (8.59±2.1mm) diameters of R-TB LNs were significantly greater than L-TB LNs (3.77±0.8 mm and 7.42±1.65 mm; p:0.001) (Figure 2). However, no significant difference was found among contralateral LC, UPT and LPT LNs. Mean short (4.03±0.9mm) and long axis diameters (7.94±1.6mm) of R-LPT LNs were significantly greater than mean short (3.64±0.79 mm) and long axis (7.1±1.49 mm) diameters of the R-UPT LNs (p:0.004). Both R-LPT LNs (mean short axis diameter, 4.03±0.9mm; mean long

Table 2: Descriptive statistics of the shortest diameters of the lymph nodes in each station

Short axis diameter	Min-max	Median	Mean±SD
R-LC	3.1-7.2	3.6	3.70±0.93
L-LC	3.1-6.1	3.5	3.45±0.74
R-UPT	2.8-6.5	3.6	3.64±0.80
L-UPT	3.6-8.2	3.5	3.63±1.31
PV	3.1-6.5	3.5	3.35±0.79
R-LPT	3.4-7.3	4.2	4.03±0.90
L-LPT	3.7-7.4	4.1	3.93±1.12
APW	3.2-5.1	3.6	3.59±0.79
PA	3.2-4.3	3.5	3.50±0.52
SC	3.6-8.7	5.3	4.79±1.06
R-TB	3.5-8.4	4.5	4.43±1.27
L-TB	3.2-6.4	4.1	3.77±0.84
Total	2.8-8.7	4.1	3.97±1

Min: minimum; max: maximum. R: Right, L: Left, LC: Lower Cervical, UPT: Upper Paratracheal, PV: Prevascular, LPT: Lower Paratracheal, PA: Paraaortic, APW: Aortopulmonary Window, SC:Subcarinal, TB:Tracheobronchial, SD: Standard deviation

Table 3. Descriptive statistics of the longest diameters of the lymph nodes in each station

Long axis diameter	Min-max	Median	Mean±SD
R-LC	5.4-13.1	7	7.11±1.84
L-LC	5.6-11.4	6.7	6.62±1.31
R-UPT	4.8-12.3	7.5	7.16±1.50
L-UPT	5.6-16.3	6.6	6.84±2.02
PV	5.4-12.6	7.3	6.82±1.70
R-LPT	5.1-14.4	8.5	7.94±1.61
L-LPT	5.6-13.0	7.4	7.74±2.14
APW	5.6-12.3	7.5	7.00±1.62
PA	6.5-9.4	8.3	7.42±1.00
SC	5.7-14.2	9.5	9.34±1.83
R-TB	5.5-15.0	8.6	8.60±2.10
L-TB	5.8-12.3	7.5	7.43±1.66

Min: minimum; max: maximum. R: Right, L: Left, LC: Lower Cervical, UPT: Upper Paratracheal, PV: Prevascular, LPT: Lower Paratracheal, PA: Paraaortic, APW: Aortopulmonary Window, SC:Subcarinal, TB:Tracheobronchial, SD: Standard deviation

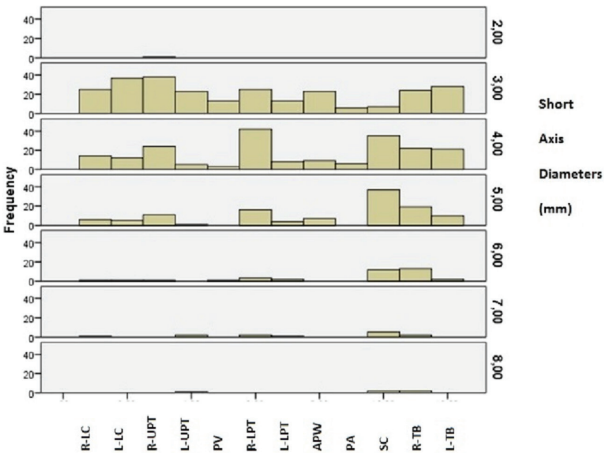

Figure 2: Histograms of the mediastinal lymph nodes; distribution of the lymph nodes by frequency and mean short axis diameters.

axis diameter, 7.94±1.6 mm) (p:0.001)) and also R-TB LNs (mean short axis diameter, 4.42±1.26; mean long axis diameter, 8.59±2.1 mm; p:0.04) were significantly smaller than SC LNs (mean short axis diameter, 4.78±1.05mm; mean long axis diameter, 9.30±1.8mm). Overall interquartile range for short axis diameters of LNs in children younger than 5 years, 5 to 10 years, and older than 10 years were 3.2-4.13 mm, 3.15-4.75mm, 3.75-5.9 mm, respectively. Overall interquartile range for long axis diameters of LNs in children younger than 5 years old, 5 to 10 years and older than 10 years were 6.2-8.23 mm, 7.35-8.7mm, 7.4-11.4 mm, respectively. Correlative results of ages and LN diameters by Spearman's correlation analysis were shown in Table 5 (Figure 3). Both short and long axis diameters of LNs located in R-LC, PV, SC, bilateral LPT and TB lymphatic stations were correlated with age ($p<0.05$) (Table 4). Mild positive correlations were found

Table 4: Lymph node prevalence by percent in each station and age groups.

Groups (months)	R-LC	L-LC	R-UPT	L-UPT	PV	R-LPT	L-LPT	PA	APW	SC	R-TB	L-TB
1 (0-24)	23	**50**	**63**	6	4	**70**	23	26	0	**70**	**66**	**60**
2 (25-60)	23	23	**50**	30	3	**53**	20	20	0	**53**	**46**	36
3 (61-120)	30	36	**50**	23	6	**56**	16	33	6	**66**	**43**	30
4 (121-80)	23	30	46	16	3	**40**	10	20	23	**53**	**43**	6
5 (181-216)	46	36	36	30	6	**66**	30	30	10	**80**	**83**	63

Min: minimum; max: maximum. R: Right, L: Left, LC: Lower Cervical, UPT: Upper Paratracheal, PV: Prevascular, LPT: Lower Paratracheal, PA: Paraaortic, APW: Aortopulmonary Window, SC:Subcarinal, TB:Tracheobronchial

Table 5: Spearman correlation analysis of the lymph node size with age in each lymphatic station.

	Short axis diameter		Long axis diameter	
	r	p	r	p
R-LC	**0.345**	**0.018**	**0.296**	**0.043**
L-LC	0.173	0.207	0.006	0.966
R-UPT	**0.266**	**0.021**	0.128	0.270
L-UPT	0.155	0.397	0.112	0.549
PV	**0.735**	**0.001**	**0.734**	**0.001**
R-LPT	**0.297**	**0.005**	**0.352**	**0.001**
L-LPT	**0.495**	**0.007**	**0.514**	**0.006**
APW	**0.435**	**0.006**	0.185	0.259
PA	0.121	0.708	**0.102**	**0.753**
SC	**0.402**	**0.001**	**0.423**	**0.001**
R-TB	**0.598**	**0.001**	**0.644**	**0.001**
L-TB	**0.697**	**0.001**	**0.602**	**0.001**

Statistically significance levels (p) and correlation coefficients (r) were given. Bold values represents statistically significant results.
R: Right, L: Left, LC: Lower Cervical, UPT: Upper Paratracheal, PV: Prevascular, LPT: Lower Paratracheal, PA: Paraaortic, APW: Aortopulmonary Window, SC:Subcarinal, TB:Tracheobronchial

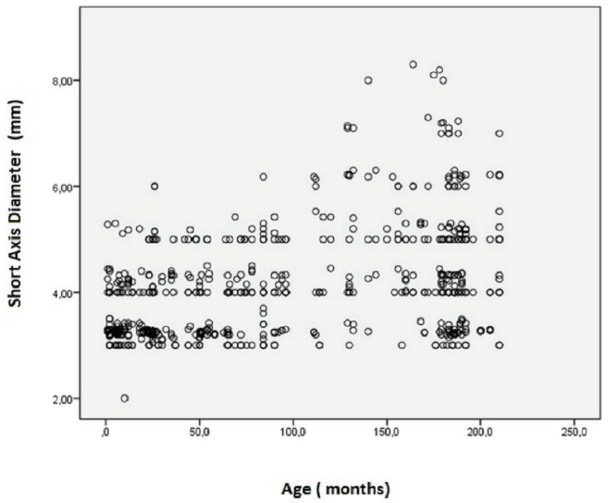

Figure 3: Scatter dot plot of the of the short axis diameters with age presenting positive correlation.

among the age groups with short axis diameters of R-LC, R-UPT, R-LPT LNs. Moderate positive correlations were found among the age groups with short axis diameters of L-LPT, APW, SC, R-TB and L-TB LNs.

DISCUSSION

Differentiation of lymphadenitis from lymphoreticular malignancies is an important diagnostic dilemma in the pediatric age group. Several studies have recently been published investigating ultrasonographic evaluation of LNs along with ultrasound based novel applications. A comparative study evaluating cervical LNs in children (6) showed that median shortest diameter, shape index and volume of the LNs were significantly higher in the lymphoma group when compared with the lymphadenitis group and the normal population. The shape index (the ratio of short axis to the long axis diameter on the longitudinal section) is a well known criteria for differentiating neoplastic processes from inflammatory and infectious disorders of LNs. Among the cases included, cut-off values for the shape index of the LNs in differentiating lymphadenitis from normal and in differentiating lymphoma from lymphadenitis were found as 55% (diagnostic accuracy: 78%) and 65% (diagnostic accuracy: 68%) respectively (6). Once a malignant lymphoproliferation begins, the shortest diameter increases more than the longest diameter and the shape of the LNs transforms to spherical from ovoid form. Therefore, the short axis diameter is worth being more focused on in cases of suspected neoplasia. On the other hand, in cases of inflammatory disorders, both long and also short axis diameters and also the number of the LNs in the lymphatic stations are expected to be increased without any architectural distortion.

Ultrasonography-based applications in many ultrasound techniques have been used to distinguish the cause of lymphadenomegaly or to differentiate them from neoplastic processes, such as elastography (7) and microvascular imaging (6) as well as scoring systems (8,9). In a study comparing the ultrasound, roentgenogram and CT findings of mediastinum in children with tuberculous infections, there were cases of mediastinal lymphadenopathy on ultrasound evaluation in most of the patients with normal radiographic evaluation, some of them also being confirmed with CT (10). Anterior mediastinal and subcarinal regions were reported to be clearly evaluated by ultrasonography and parasternal approach by differentiating hypoechogenic LNs from the hyperechogenic mediastinal fat tissue (11,12). Mediastinal radioopacities seen on chest roentgenograms of children should be demonstrated with real time ultrasonography as a radiation free imaging modality providing also a biopsy guidance. Therefore, ultrasonography would be used both in determining paratracheal and aortopulmonary LNs (11)and also for follow-up. On the other hand, in contrary to superficial lymphatic stations such as cervical, axillary and inguinal lymphatic stations, all of the mediastinal lymphatic stations especially hilar regions could not be evaluated clearly by ultrasonography based applications due to pulmonary artifacts. CT and magnetic resonance imaging of the chest have considerable diagnostic value in detection of mediastinal LNs. Magnetic resonance imaging modality has several limitations in early childhood such as the need of sedation, being late and expensive to perform. However, MRI provides novel technical advantages by parallel imaging, shared echo-technique and rotating phase encoding to deal with cardiac and respiratuar motion in addition to its previously known superiority as providing functional and chemical information (13). CT provides higher geometrical resolution due to thin slices but has a general limitation as radiation exposure. There was a high correlation between CT data and cadaveric studies in adults especially in right sided (14) mediastinal and hilar LNs (15). The dependence of the LN size to the location (15) and predictive value of the short axis diameter for LN volume were been reported (14). The points to be discussed are the normal size range and incidence of the mediastinal LNs for the healthy pediatric population which would be clarified with a gold standard imaging modality such as CT examination of the chest. Dimensional evaluation of the mediastinal and hilar LNs in the healthy pediatric population would provide a great deal of data in decision making. Therefore, previous chest CT data of the healthy children is invaluable in providing a normative scale for mediastinal LNs.

There has not been enough reported data concerning the normal size of mediastinal and hilar LN in children detected by CT examination. Miller at al. evaluated 213 patients aged newborn to twenty years without previous intrathoracic pathology or malignancy and reported no depicted mediastinal LNs (16). Delacourt at al. examined chest CT of ten patients without bronchopulmonary infection

within the six weeks prior to the examination. They found only right paratracheal and hilar LNs with smaller diameters. Cut-off values of LN diameters for R-PT lymphatic station were reported as 5 mm in children younger than four years of age and 7 mm in children older than 8 years of age, while those were 4mm and 6mm for hilar zones respectively (17). These studies were not satisfactory after providing thinner slices with multidetector CT devices.

Technological developments allow thin section CT images with increased contrast and geometrical resolution in addition to decreased artifacts. However, mediastinal enlargement especially in early childhood would be confusing because of the limited mediastinal fat tissue as a distinguishing endogeneous contrast. CT examinations in early ages require intravenous contrast medium injection. In terms of quality, mediastinal vessels and thymus would obscure lymphatic stations and non-enhanced CT would be false negative especially in infants and younger children. We selected chest CT examinations with intravenous contrast administration for evaluation of any solid organ laseration after trauma in order to deal with this problem. Heterogeneous enhancement (18), and 'ghost-like' ring enhancement of LNs (19) are described for specific infections such as tuberculosis lymphadenitis which could be diagnosed with contrast enhanced CT. Slice thickness is a technical parameter that is important when comparing with follow-up studies. The images we selected had been obtained with 0.5mm slice thickness that is adequate to detect all clinically significant LNs in all mediastinal stations. Previous data regarding mediastinal LN size of children on multidetector CT has been provided in recent studies with 5 mm (n:120) (20) and 0.65 mm (n: 99) (21) slice thickness. We detected at least one LN in 99.7% of the patients. Our inspection ratio was similar but slightly higher than Jong et al. (%96) (20) and significantly higher in contrast to previous studies reporting no detectable mediastinal LNs in children (16). The slightly higher incidence of our LN detection rate could be due to thinner slices. Therefore, the presence of the LNs would be assessed as normal but size and numbers have to be elaborated. The relatively lower incidence (82%) detected by the recent study, could be explained by the inhomogeneous age group and older age group (median; age range: 13.5 years; 4-18) (21). We found commonly encountered LNs in the SC (64%), R-LPT (57%), R-TB (56%), R-UPT (49%) and L-TB (39%) regions. The reported incidences were similar to the findings of Jong et al. (20) except the lower incidence of APW LNs in our study and we found a higher incidence of SC LNs than in the previous study (21) (15%). PV and paraesophageal lymphatic stations were less commonly encountered locations in our study.

It is a point of interest if the diameters of the LNs change among lymphatic station and age groups. In contrary to the thymic tissue regress by adolescent age group, the number and diameter of the LNs may increase by age due to uninvolutional duration. A recent study revealed an increase in number of the LNs in children older than ten years relative to first decade (21). Additionally, our findings revealed a significant increase in both short and long axis dimensions by age. Interquartile range for short and long diameters of LNs of children younger than 5 years, 5 to 10 years and older than 10 years old increases respectively in correlation with these results. Short axis diameters larger than 6 mm and long axis diameter larger than 11 mm should be evaluated carefully at any age. Maximal diameters of the LNs detected in recent studies were up to 7mm in the general pediatric population (21). In correlation with this, some studies report this to be 7 mm in children up to 10 years old (20), and 10 mm in children older than 10 years old. Along with increased size and age threshold , significant positive correlation of the size with age, have been reported in our study and also in previous data (20). The largest mean diameter was found for SC lymphatic station without significant difference of means among different lymphatic stations (21). An added diagnostic value of our study in relation to the previous data is the location dependant size range with a large scale study. We documented significant difference of the mean longest and shortest diameters among SC, LPT and UPT LNs. These lymphatic stations can be arranged as SC, LPT and UPT from larger to smaller respectively. As the jugulodigastric LNs are greater than other anterior and posterior cervical LNs, the mediastinal LN size should be managed based on the site in which it is located. SC LNs have been reported as more prominent in healthy adults (22), of which the largest regress more slowly or they persist. Although, the subcarinal LNs are more likely to be obscured with cardiac siluet on chest roentgenograms, radiologists should be aware of the highest inspection ratio and also larger diameters of SC LNs to rule out any lymphadenomegaly. Lateral chest roentgenogram has been reported as superior to the posteroanterior roentgenograms (23) for detection of SC LNs. Also, the thickness of the right paratracheal line corresponding to R-UPT and R-LPT lymphatic stations on chest roentgenograms gains importance with the results of our study. Since the largest diameter of short axis dimensions of LNs were smaller than 4 mm, a paratracheal line thicker than 4 mm should be evaluated with doubt.

Mediastinal lymphadenopathy in children has been reported as a fingerprint of pulmonary tuberculosis infection (24). The only positive finding in a symptomatic patient in childhood tuberculosis may be lymphadenopathy (25) which is commonly encountered in the SC region (19). Association of lymphadenopathy with tuberculosis infection has been found stronger than community acquired bacterial pneumonia (26). In studies performed on pediatric patients with tuberculosis infection, 46% of them presented LNs larger than 1cm (24,27) which is not common in the

healthy population. The frequency of enlarged LN distribution in patients with tuberculosis was found to be in SC (90%), TB (85%) and anterior mediastinal (79%) (19) which are greater than the incidence seen in the normal pediatric population. The most common sites were reported as RPT followed by TB (25,28), PT (84.1%), SC (76.1%), pretracheal (56.8%), precarinal (54.5%), and right TB (52.3%) (18) lymphatic stations. Although the presence of the LNs supports the diagnosis of infectious disease, the maximal shortest diameter would be more effective in supportingthe presence of pulmonary infection in association with lymphadenitis. Lack of size criteria in clinical practice for detected mediastinal LNs in children has been discussed (29) and we provided thresholds based on lymphatic sites and also age groups with a large scale data. The most common pathological LNs infected with tuberculosis and also commonly encountered physiological LNs in our study are seen in the R-UPT and R-LPT regions. A study comparing simultaneous radiographs and chest CT of the infected children revealed that up to 60% of the infected children presenting normal chest radiograph showed lymphadenopathy on CT (17). Therefore in suspected contact and clinical outcome, chest CT examinations would help us to achieve clear diagnosis with clear cut-off values.

Our study has some limitations. The first is that retrospective design was preferred because of the radiation exposure, therefore the included patient population was heterogeneous. Despite the exclusion criteria, we could not exclude extrapulmonary lymph node infections without significant necrosis and calcification. We could not widely achieve the immune and nutritional status of the participants.

In conclusion, an increased number of examinations and advanced technologic devices cause the LNs to be more visible. Malignant lymphoproliferative disorders and specific infections as tuberculous are higher within the first decade of a child's life. In contrast to adults, children with tuberculosis contacted in underdeveloped countries and at pre-adolescent age are at high risk of developing tuberculosis, especially as lymphadenitis form, and also this group has a higher risk of pulmonary infection. In order to treat the patient with antituberculous treatment, the status of the mediastinal LNs should be clearly examined. Any deviation of mediastinal lymph node size from normal distribution should be reported to healthcare professionals as a pathological finding. The fine boundary between prophylaxis and treatment options depends on the size of the lymph nodes. Being aware of normal size range based on age groups and based on lymphatic stations would facilitate the management and reduce redundant diagnostic interventions and excess medication.

Ethics Committee Approval: This study was approved by the İstanbul Faculty of Medicine Local Ethics Committee. (No: 2015/1738).

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