

ULTRASOUND OF THE CHEST

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Chest X-rays have stood the test of time as a simple and highly effective mode of investigation in the pediatric patient. A systematic interpretation of properly obtained radiographs offers a definitive diagnosis in many conditions; thus, obviating the need for more costly and time consuming diagnostic procedures.

However, when dealing with large chest lesions it may be difficult to judge whether the opacity seen in the chest X-ray is arising from the pulmonary parenchyma, pleura or mediastinum. Ultrasound (US) examination of the chest is of immense value in these difficult situations. US is relatively inexpensive, free from ionizing radiation and almost universally available. In this article we highlight the complimentary roles of chest X-ray and US in solving

certain diagnostic dilemmas in the pediatric chest.

When compared to its applications elsewhere in the body, the role of US in diagnosis of diseases of the chest is limited. This is mainly due to the physical limitations imposed by the aerated lung and the surrounding bony thorax. The normal lung is highly reflective and transmits sound poorly while the ribs do not allow the sound beam to pass through them. But, whenever a pathologic process in the thoracic cavity becomes large enough to displace the aerated lung, it can be detected by an appropriately placed ultrasound probe. The approach to the lesion has to be varied in each instance according to its position. Those lesions which abut the lateral chest wall can be imaged by keeping the transducer over the chest wall and directing the beam through the intercostal spaces. Small lesions arising from the mediastinum can be imaged by a transducer kept in the parasternal position or in the suprasternal notch. Juxta-diaphragmatic lesions are best imaged through a contiguous soft tissue structure like the liver.

Mediastinal Masses

Among the various lesions that can be effectively diagnosed using ultrasound, mediastinal masses form an important group. They are not an uncommon problem in the pediatric age and these patients often come to the attention of the physician because of respiratory distress, recurrent pneumonia, stridor, dysphagia or cyanosis. Plain films of the chest and barium esophagograms are the only studies required in most cases.

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Accepted: December 18, 1992

The plain X-ray findings suggestive of a mediastinal mass are:

1. The medial margin of the opacity merges with the mediastinum.
2. The lateral margin of the opacity is usually well defined.
3. Displacement of the trachea or esophagus.
4. Involvement of the spine or the adjacent ribs or the sternum.

Anteroposterior and lateral films of the chest will often localize the lesion into one of the compartments of the mediastinum. The tracheal and esophageal shadows by their displacement anteriorly or posteriorly will greatly aid in this. The conventional division of the mediastinum into anterior, middle and posterior parts and the lesions which preferentially arise in each of these is well known. (Table I)(1,2).

The features that we have discussed so far are of help only when the lesion is small to moderate in size. Once the tumor becomes very large, it will fill almost the en-

tire hemithorax producing considerable diagnostic difficulties. The radiological appearance in this condition will be that of a large opaque hemithorax. In the child and the infant the single most common cause for a large opaque hemithorax is empyema (Table II). But one should always keep in mind the possibility of a large mediastinal mass, especially in those patients with atypical presentations and those who do not show a good response to medical treatment(3). The chest X-rays should be carefully evaluated and the role of the radiologist in this is very important. US of the chest will prove to be of great value in these difficult situations. We shall illustrate this with the following examples.

Case 1: Figs. 1 a & b show the AP and right lateral chest X-ray of a 6-month-old male child admitted to the pediatric ward with a history of increasing breathlessness and intermittent fever for two months. Examination revealed a dull percussion note over the right hemithorax and diminished breath sounds over the same

TABLE I—Classification of Mediastinal Masses in Children.

	Posterior mediastinum	Middle mediastinum	Anterior mediastinum
Common—	Neuroblastomas Ganglioneuromas Neurofibromas Meningoceles Neurenteric cysts	Enlarged lymphnodes Bronchogenic cysts	Dermoids Teratomas
Rare—	Sequestrations Diaphragmatic hernias Teratomas		Tumours of thyroid & thymus

* Cystic hygromas and lymphomas can arise in any compartment or need not be localized to a particular compartment.

TABLE II—Differential Diagnosis of Large Opaque Hemithorax on the Chest X-ray.

(a) Fluid in the pleural space	<ul style="list-style-type: none"> — Empyema — Effusion secondary to tuberculosis, fungal infections, pancreatitis. — Effusion secondary to lymphoma, neuroblastoma, metastasis. — Hemothorax and chylothorax.
(b) Large masses arising from mediastinum. and in new born	<ul style="list-style-type: none"> — Diaphragmatic hernia. — Fluid filled lobe of congenital lobar emphysema.

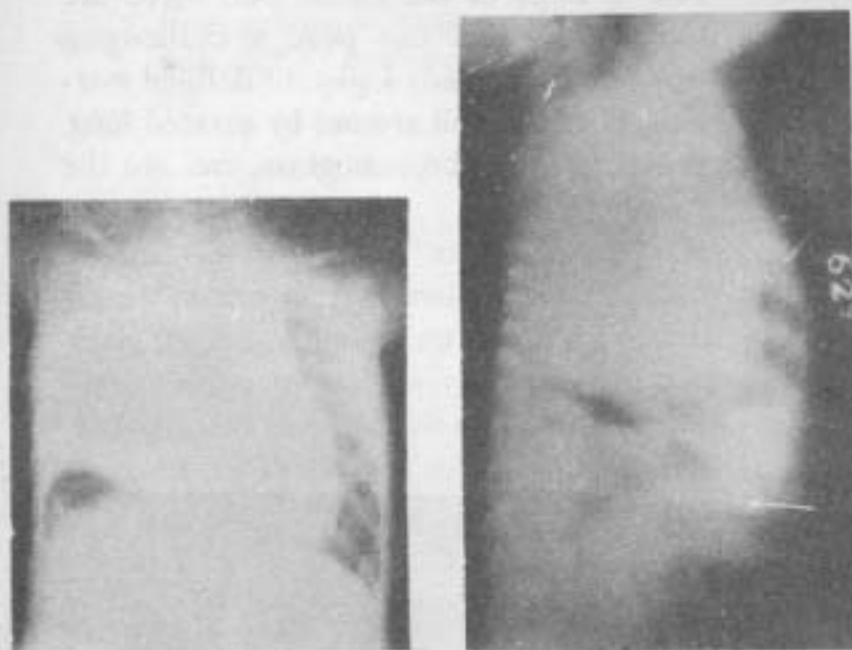


Fig. 1. Chest AP (a) and right lateral (b). AP film shows an opaque right hemithorax with marked tracheal deviation to the left. Lateral view shows a central trachea and the lobulated inferior border of the opacity.

area. A provisional diagnosis of empyema was made.

The chest X-ray shows a dense homogeneous opacity occupying almost the en-



Fig. 2. Mediastinal cystic hygroma—Coronal US done through the intercostal space showing multiple cystic spaces separated by thin septations.

tire right hemithorax, medially continuous with the mediastinal shadow and laterally extending up to the chest wall. The lower margin of the opacity is well defined and

marked tracheal deviation to the left is seen. The right lateral view shows the trachea to be central with the opacity extending both anterior and posterior to it.

Loculated empyema should be considered in this child, but empyemas are usually associated with an element of free pleural fluid and the continuity of the shadow with the mediastinum should raise the possibility of a mediastinal mass. A US of the chest was done at this stage.

Sonography revealed a large cystic lesion with thin delicate septations dividing it into loculations (*Figs. 2 a & b*). These findings are almost diagnostic of a mediastinal cystic hygroma(4,5). Usually intrathoracic cystic hygromas have a component in the neck(1,6,7). Primary mediastinal cystic hygromas without a component in the neck, as in this case, are rare(8,9).

The child was operated upon without delay and the mass was removed piece-

meal. Biopsy confirmed the tumor as a lymphangioma.

Case 2: *Fig. 3a* is the chest *X*-ray of a 4-year-old female child. There are ill defined opacities in both lung fields and the cardiac borders are obliterated. These opacities were interpreted as pneumonia and treated with various antibiotics. The failure of the child to respond prompted a US of the chest to be done. The characteristic hypoechoic lobulated mass of lymphoma was seen (*Fig. 3b*) and this was confirmed by a fine needle aspiration done under US guidance.

Differentiating a parenchymal pathology like consolidation and a mediastinal pathology from the chest *X*-ray is not difficult in most of the cases, but, there are times when this can pose a challenging problem to the radiologist. Ill defined margins, bordering all around by aerated lung, presence of air bronchogram, *etc.* are the



Fig. 3(a). Posteroanterior chest film showing opacities in both lung fields with obliteration of the cardiac borders.



Fig. 3(b). Mediastinal lymphoma—US of the chest through the liver showing the hypoechoic lobulated mass (M). H—Heart.



Fig. 4(a). Empyema—Posteroanterior film. Homogeneously opaque right hemithorax with shift of mediastinal structures to the left.



Fig. 4(b). Empyema—Coronal US through the lower right intercostal space. Sonolucent collection in the pleural space. LIV—right lobe of liver.

typical findings in a consolidation. But some of the mediastinal masses, particularly the lymphomas, can present a picture very similar to a lobar or segmental consolidation. This could be due to actual lung invasion by the tumor or more commonly due to compression of the principal or lobar bronchi by nodes(1). In all atypical parenchymal opacities in the lung a high index of suspicion should be maintained and a thorough search should be made for the presence of a hidden mediastinal mass. In this context also US is of invaluable help for it can precisely identify and locate any underlying condition(5,10).

Pleural Pathologies

Pleural pathologies like empyemas can be easily and accurately diagnosed using US. *Fig. 4a* is the chest X-ray of a 2-year-

old child which shows a large opaque right hemithorax. This is a typical example of empyema and *Fig. 4b* shows the ultrasound appearance of the same. The sonolucent fluid collection in the pleural space with echogenic material representing debris is characteristic. Eventhough the chest X-ray does not offer any problems in diagnosing uncomplicated cases of empyema, a US examination of the chest is in order, for it not only gives a prompt diagnosis, but helps to mark the most suitable site for aspiration as well, if needed(4,5,11). In addition US can detect an underlying tumor hidden by an associated massive pleural effusion. In loculated empyemas, the chest X-ray can be quite puzzling. US should be the next step in these cases so that the nature of the lesion can be ascertained and a thoracentesis undertaken if necessary(1,2).

Juxtadiaphragmatic abnormalities also can be satisfactorily imaged using ultrasound. US is very valuable in conditions like diaphragmatic hernias, eventration or paralysis, subdiaphragmatic abscess and subpulmonic effusions.

Limitations

There are various handicaps for this imaging modality when applied to the chest, as mentioned earlier. In addition, lesions which are placed very deep or shielded by structures like the scapula are inaccessible to US. The image of lesions situated very superficially may be severely degraded by reverberation artifacts from the ribs. Another difficulty in infants and children is in acquiring images without significant degradation produced by movement. Ultrasound also has limitations in distinguishing normal from abnormal tissues—examples being the inability to differentiate normal thymus from pathologically enlarged thymus and atelectatic lung from pathologically consolidated lung(5).

Conclusion

To conclude, we stress that an ultrasound of the chest should be done for all patients in whom it is difficult to localize and define a large opacity in the chest radiograph. Ultrasound is highly sensitive and specific for evaluating pleural pathologies. The most important role of ultrasound in the evaluation of mediastinal masses is in detecting whether the lesion is cystic or solid. It can also characterize the lesion by its internal architecture, particularly those which lie close to the chest wall or the diaphragm. Because of its inherent limitations, chest sonography may be inconclusive in some patients, particularly in those with small mediastinal masses. In

these patients, computed tomography may have to be done. However, satisfactory sonographic evaluation can be done in the majority and the required information can be obtained at a lower cost and without exposure to ionizing radiation. A detailed evaluation of the chest X-rays coupled with judicious use of ultrasound can tackle many a diagnostic dilemma in the pediatric chest.

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NOTES AND NEWS

GROUP ON CHILDHOOD DISABILITY

A group on Childhood Disability has been formed under the aegis of the IAP. This is a multidisciplinary group which will be working for the welfare of disabled children of the country. The aim of this group is to collect information from all over the world regarding their prevalence, management and rehabilitation of these children. Educating the parents will also be one of the aims of this group.

Membership fees:

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| 1. Ordinary Member | Rs. 100/- per year <i>or</i>
Rs. 1000/- life membership |
| 2. Associate Member
(for non-pediatricians) | Rs. 50/- per year <i>or</i>
Rs. 500/- life membership |

Members interested in the total welfare of disabled children are requested to apply for the membership of this group to:

Dr. S.D. Singh,
Professor and Head,
Department of Pediatrics,
11, Film Colony,
Indore.