# COMPLICATED FORMS OF PRIMARY TUBERCULOSIS IN CHILDREN AND ADOLESCENTS

L.P. Shepeleva, N.A. Nikiforova

State Budgetary Institution of the Sakha Republic (Yakutia) "Research & Practice Center 'Phthisiatry'"

**Summary.** Analysis of complicated forms of pediatric primary tuberculosis is presented, based on x-ray findings of 45 patients, treated in the 'Phthisiatry' Research & Practice Center, Sakha Republic (Yakutia). The study revealed that clinical x-ray pattern of primary tuberculosis complex correlated with age factor. We observed that due to age-specific host responsiveness differences, a complicated clinical progression of primary tuberculosis complex occurred more often in adolescents and infants, and manifested as bronchopulmonary involvement with generalization of the process spreading to other organs and systems. In preschool and junior school age, an unfavorable tuberculosis progression was far rarer exclusion and manifested predominantly as lymphogenous seeding.

**Keywords:** primary tuberculosis, complications, children, adolescents, computed tomography.

X-ray findings of 155 children and adolescents with tuberculosis (TB) of intrathoracic lymph nodes or primary tuberculosis complex have been analyzed in the 'Phthisiatry' Research & Practice Center, to study CT-based semiotics of primary tuberculosis. Complicated disease forms were found in 45 out of 155 patients (29%). In half of the patients, the specific process was complicated by 2 and more complications, of which lymphogenic seeding (45.4%) and bronchopulmonary involvement (18.2%) were diagnosed most often.

**Complications of primary tuberculosis in children and adolescents**

| Complications of primary tuberculosis: | Age groups (n) | | | | Total (n=155) |
|---|---|---|---|---|---|
| | 0-3 year (n=52) | 4-6 year (n=50) | 7-13 year (n=48) | 14-17 year (n=5) | |
| *Total number of children with complications:* | *13 (25%)* | *13 (26%)* | *16 (33%)* | *3 (40%)* | *45 (29.0%)* |
| Bronchopulmonary involvement | 5 | 4 | 2 | 1 | 12 (18.2%) |
| Bronchonodular fistula | - | 1 | - | - | 1 (1.5%) |
| Bronchogenic seeding | 1 | 2 | 3 | 1 | 7 (10.6%) |
| Lymphogenic seeding | 8 | 9 | 12 | 1 | 30 (45.4%) |
| Hematogenic seeding | 2 | - | - | 1 | 3 (4.6%) |
| Pleurisy | - | 1 | 3 | - | 4 (6.0%) |
| Destruction | 1 | - | 1 | 1 | 3 (4.6%) |
| Chronic tuberculosis | - | 1 | 2 | - | 3 (4.6%) |
| Infiltrative exacerbation | - | 1 | - | - | 1 (1.5%) |
| Generalized tuberculosis, including: | 2 | - | - | - | 2 (3.0%) |
| Meningitis | - | - | - | - | - |
| Involvement of bones | 1 | - | - | - | 1 |
| Involvement of vertebrae | 1 | - | - | - | 1 |
| Enlargement of intra-abdominal lymph nodes | - | - | - | - | 1 |
| Involvement of adrenal gland | 1 | - | - | - | - |
| *Number of complications:* | *19 (28.8%)* | *19 (28.8%)* | *23 (34.8%)* | *5 (7.6%)* | *66 (100%)* |

The clinical and radiological manifestations of intrathoracic processes showed some age-specific differences. Based on them, patients were divided to 4 age groups (Table).

In children aged 0 to 3, more severe forms of complications, such as generalization of TB infection to other organs or bronchopulmonary involvement, are found more often than in other age groups. Primary pneumonic alterations in children from this age group often occupy a large part of the lung or an entire lobe. These patients are detected mostly on visit to a hospital. The most frequent diagnosis is pneumonia, and following the inefficiency of nonspecific antibacterial therapy differential diagnosis for presence of TB is required. On x-ray pictures, caseous process in mediastinal lymph nodes manifesting as tumor-like bronchadenitis was especially pronounced in early age; in such cases tuberculosis was characterized by predominant presence of large parcels of caseation-alterated lymph nodes.

*Monitoring 1.* 4 month old child. Right lung has diminished volume. Heterogeneous consolidation area in lung tissue with signs of athelectasis is recognizable in segments S1, S3 and in right middle lobe. Within the consolidation area, lumina of dilated bronchi and an ovoid cavity sized 1.3x1.1x0.8 sm are seen. The rest of lung compartments show heterogeneously decreased pneumatization and the presence of multiple disseminated foci, in some places merged into infiltration areas with indistinct boundaries.

Conglomerates formed by perivascular, paratracheal, tracheobronchial (2.0x1.98x2.5 sm),

subcarinal (1.28x1.34x1.47 sm), right bronchopulmonary (1.2x0.9x0.8 sm) lymph node groups are identified in hilar structure and in upper mediastinum.

Diagnosis: tumor-like form of tuberculosis of the intrathoracic lymph nodes, complicated with bronchopulmonary involvement leading to tissue destruction and lymphohematogenous seeding (fig. 1).

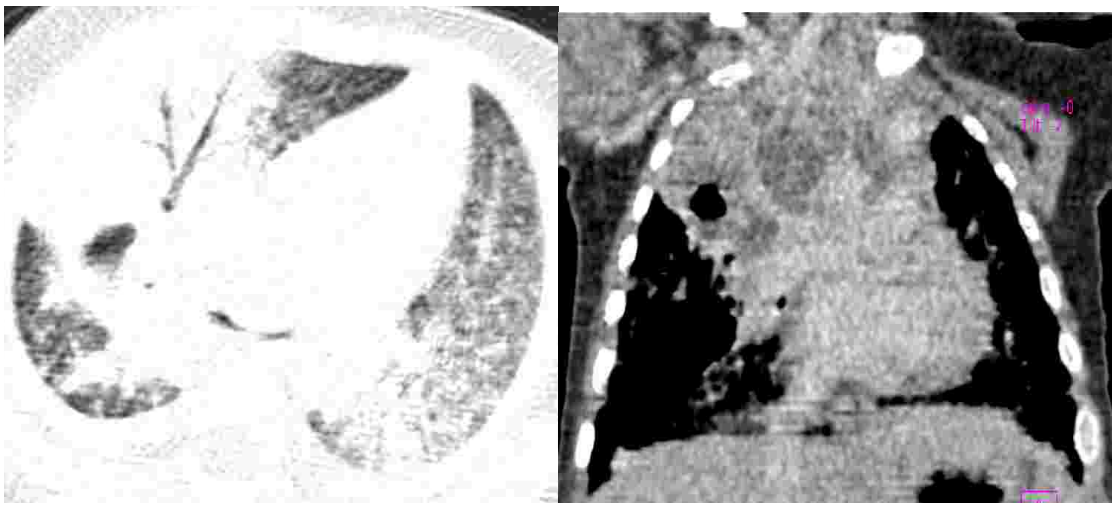


*Fig. 1.* Computed tomography of the lungs and mediastinum. Tumor-like form of tuberculosis of the intrathoracic lymph nodes, complicated with bronchopulmonary involvement leading to tissue destruction and lymphohematogenous seeding.

Direct signs of bronchial involvement were bronchial obstruction, altered diameter and deformed walls of the bronchi. Indirect symptoms were various degrees of impaired bronchial lumen patency ranging from hypoventilation to atelectasis, which appeared on CT as well-defined areas of diminished and thickened lung tissue.

Development of bronchonodular fistula was one of complications, which was a precondition to the invasion of caseous-necrotic matter from the molten lymph nodes to bronchial lumina, causing a bronchogenous dissemination.

*Monitoring 2.* 4 year old child. In segments S1, S2, S3 of left lung, consolidation area with densitometric value of 45-67 HU is identified; it has heterogeneous composition and patches of early-stage calcification. In segments S2, S6, S8, S10 of right lung, subpleural solitary focal opacities with distinct boundaries are seen.

Bronchonodular fistula is seen located at the level of left upper-lobe bronchus and manifesting as both-sided bronchial wall defect reaching 6 mm. in width.

Diagnosis: tuberculosis of the intrathoracic lymph nodes in the infiltration phase (tumor-like form), complicated with bronchopulmonary involvement. Bronchonodular fistula of the left upper-lobe bronchus (fig. 2).

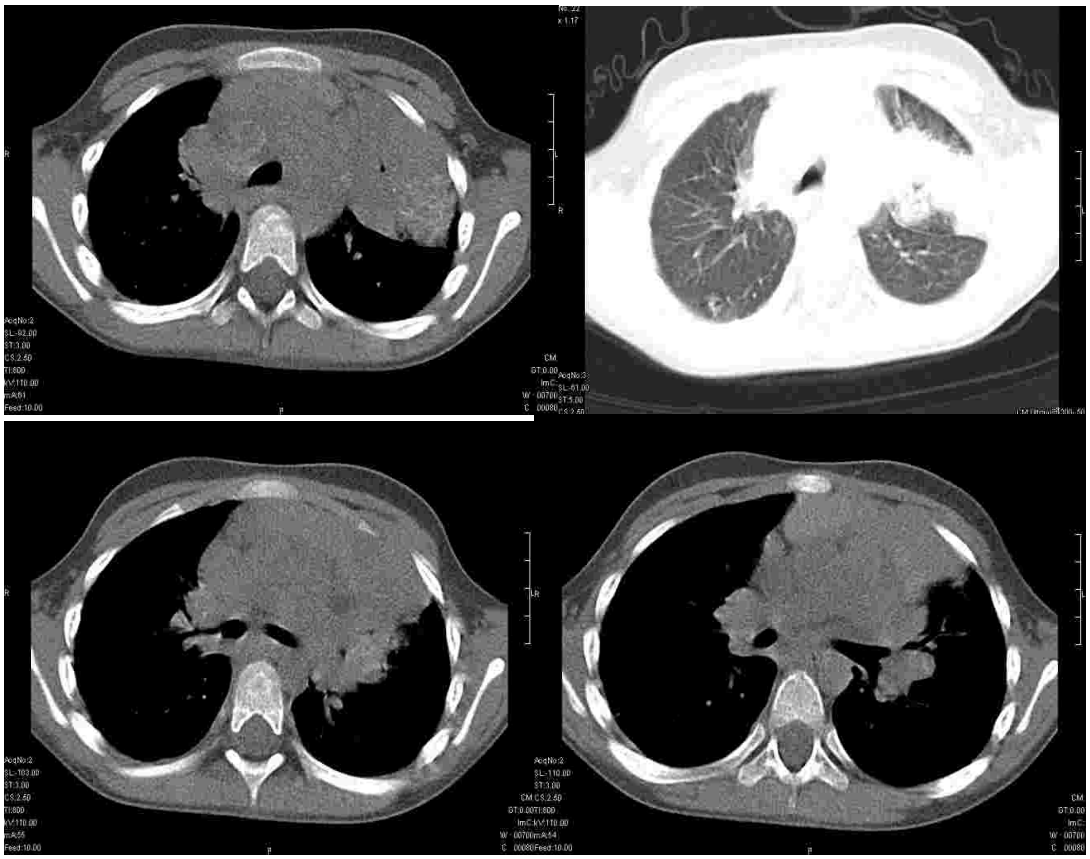


*Fig. 2.* Computed tomography of the lungs and mediastinum. Tuberculosis of the intrathoracic lymph nodes in the infiltration phase (tumor-like form), complicated with bronchopulmonary involvement. Bronchonodular fistula of the left upper-lobe bronchus.

Tendency to generalization and to hematogenous dissemination of the process was one of the most noticeable features of primary tuberculosis in infants. One of characteristic features in acute microfocal and miliary disseminations was the presence of multiple monomorphous foci distributed over the lungs from apices to diaphragm. These focal alterations were accompanied by a mild response of interstitial structures, which manifested as a diffuse thickening of interlobular intersticium. A characteristic feature in subacute hematogenous disseminations was the development of numerous homogeneous or polymorphous foci in the lungs. And the upper lobes were predominant sites, where alterations took place.

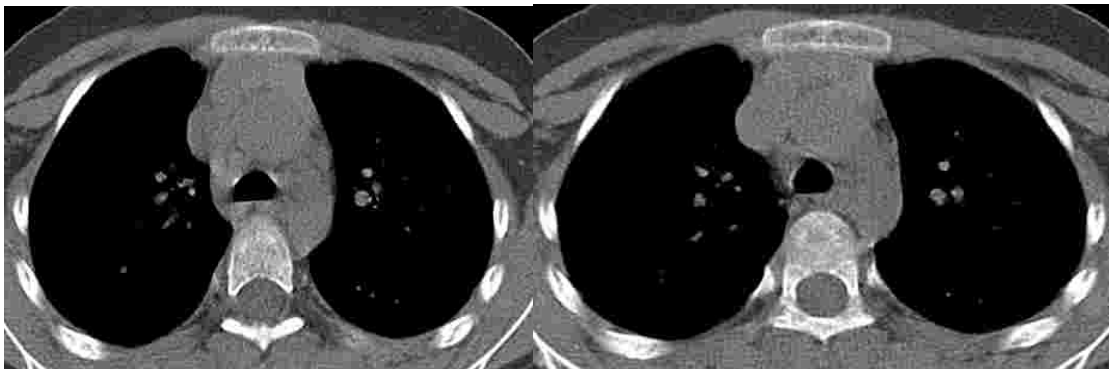
Lymphogenous tuberculous dissemination was seen more often in preschool and school children (groups 2 and 3) and was marked by irregular pattern of involvements. The alterations had predominantly subpleural localization and appeared as productive foci of medium density with relatively well-defined boundaries, 0.3 to 0.5 sm. large. These foci were found more often in anterior and posterior segments of the upper lung lobes, in apical segments of lower lobes, in lingular segments and in middle lobes.

A slower progression of primary TB was more common in children from these age-groups. If the pulmonary process with acute onset was later followed by a prolonged disease course, this was the reason to consider chronic process. Lymphotropic nature of *M.tuberculosis* was seen in the tendency of the disease towards lympho-glandular progression with involvement of new groups of lymph nodes.

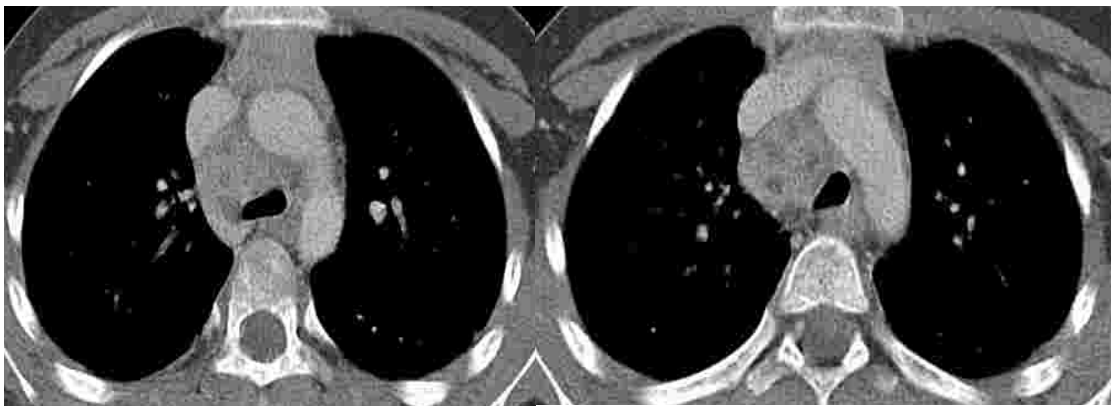
*Monitoring 3.* 7 year old child. Upper mediastinum reveals homogeneous retrocaval and subcarinal lymph nodes sized up to 0.7-0.9 sm. After 3 months of specific treatment, negative tendency is observed, manifesting as enlargement of lymph nodes along with development of

conglomerates sized 5.3x2.9x3.0 sm and with 24-35 HU density on native scans. Contrasting resulted in increase of the density up to 94-99 HU. The structure of lymph node conglomerate is heterogeneous, with small hypodense areas of necrosis.

Diagnosis: tumor-like form of tuberculosis of the intrathoracic lymph nodes (infiltrative exacerbation) (fig. 3).



At first visit



After 3 months of treatment

*Fig.3.* Computed tomography of the lungs and mediastinum. Tumor-like form of tuberculosis of the intrathoracic lymph nodes (infiltrative exacerbation).

Involvement of pleura in primary TB occurred in 6% of preschool and school children. Pleurisy in primary TB is always a complication, as far as serous membranes are especially sensitive to inflammatory responses that develop during the first phase of infection. Besides, because the lymphatics of hilum and pleura are directly interconnected, inflammatory process can easily spread on pleura.

Destruction of pulmonary tissue was the rarest complication in a primary tuberculosis complex. Such alterations may take place in an affected lymph node as well. In this case a “glandular cavity” is diagnosed on CT.

Tendency towards progressive disease is observed more often in adolescence, compared to early preschool and preschool age, along with clinically favorable forms of tuberculosis that also develop in this age. Almost all intrathoracic lymph node groups (6 and more groups) can be involved in the process.

*Monitoring 4.* 16 year old patient. S2 and S6 of left lung show multiple peribronchial centrilobular small foci.

Multiple enlarged paratracheal, retrocaval, subcarinal, para-aortic, left and right bronchopulmonary lymph node groups are visualized, merging into conglomerates.

Diagnosis: tumor-like form of tuberculosis of the intrathoracic lymph nodes, complicated with lymphohematogenous seeding (fig. 4).

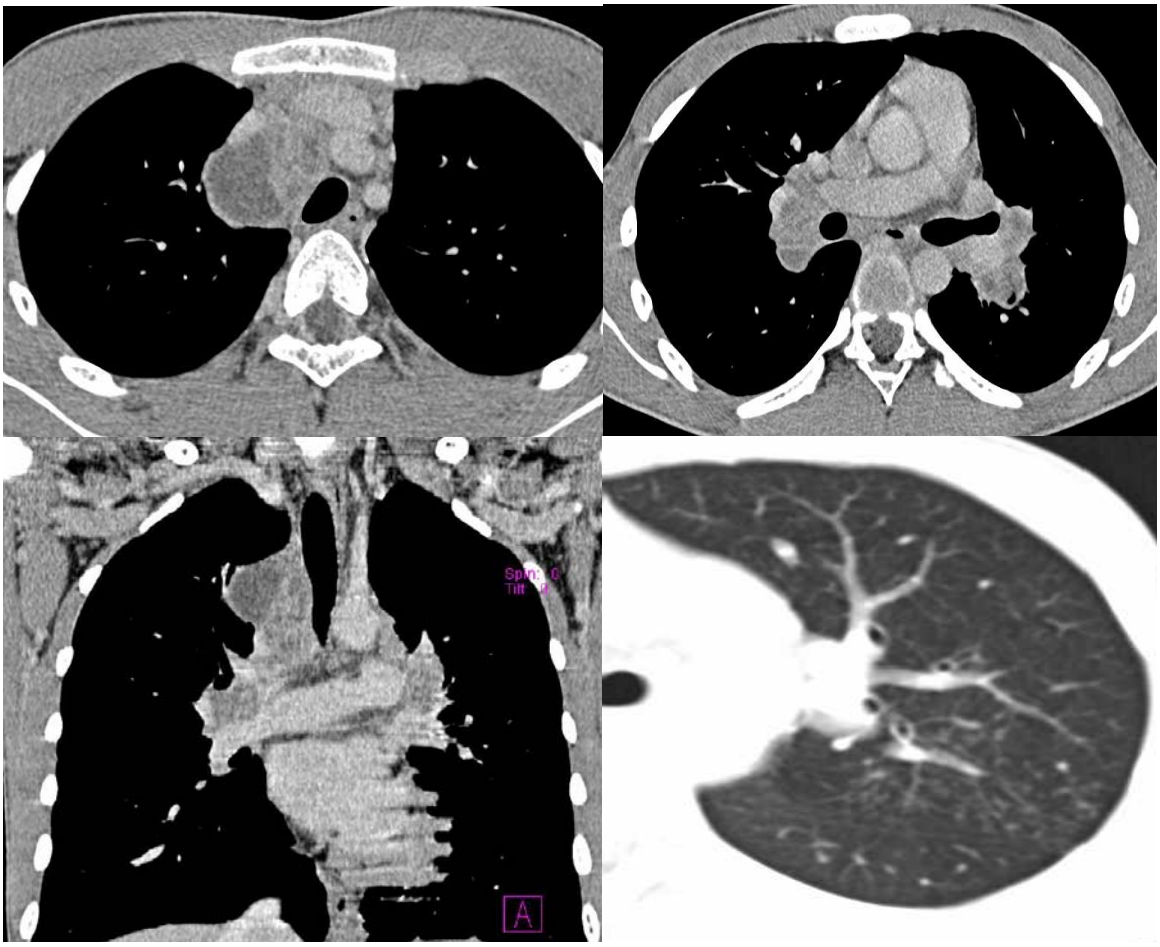


*Fig. 4.* Computed tomography of the lungs and mediastinum. Tumor-like form of tuberculosis of the intrathoracic lymph nodes, complicated with lymphohematogenous seeding.

Along with the involvement of lymph nodes, miliary, acinar and exudative lobular foci were found, as a byproduct of either hematogenous and lymphogenous generalization, or bronchogenous spread of infection. Marked exudative response, necrosis, and development of cavities, all of which are signs of a progressive disease were seen in adolescents. In the presence of preexisting primary tuberculosis that started to develop in the past but stopped in early phase, adolescents developed pulmonary alterations that are indicative of secondary forms of tuberculosis.

*Monitoring 5.* 14 year old patient. In right segments S1, S2, S3 and in left segments S1, S2, S3, S4, S5 multiple cavities and deformed bronchial lumina are recognized in the presence of preexisting extensive infiltration.

In the lower compartments of lungs, there are multiple low density foci of various sizes, merging into areas of infiltration.

Lung hila are broad and reveal numerous hyperplastic bronchopulmonary lymph nodes with small patches of calcium. Upper mediastinum shows hyperplastic perivascular, retrocaval, para-aortic, subcarinal, paraesophageal lymph nodes sized up to 1.5 sm.

Diagnosis: Bilateral caseous pneumonia (complication of tuberculosis of the intrathoracic lymph nodes) (fig. 5).

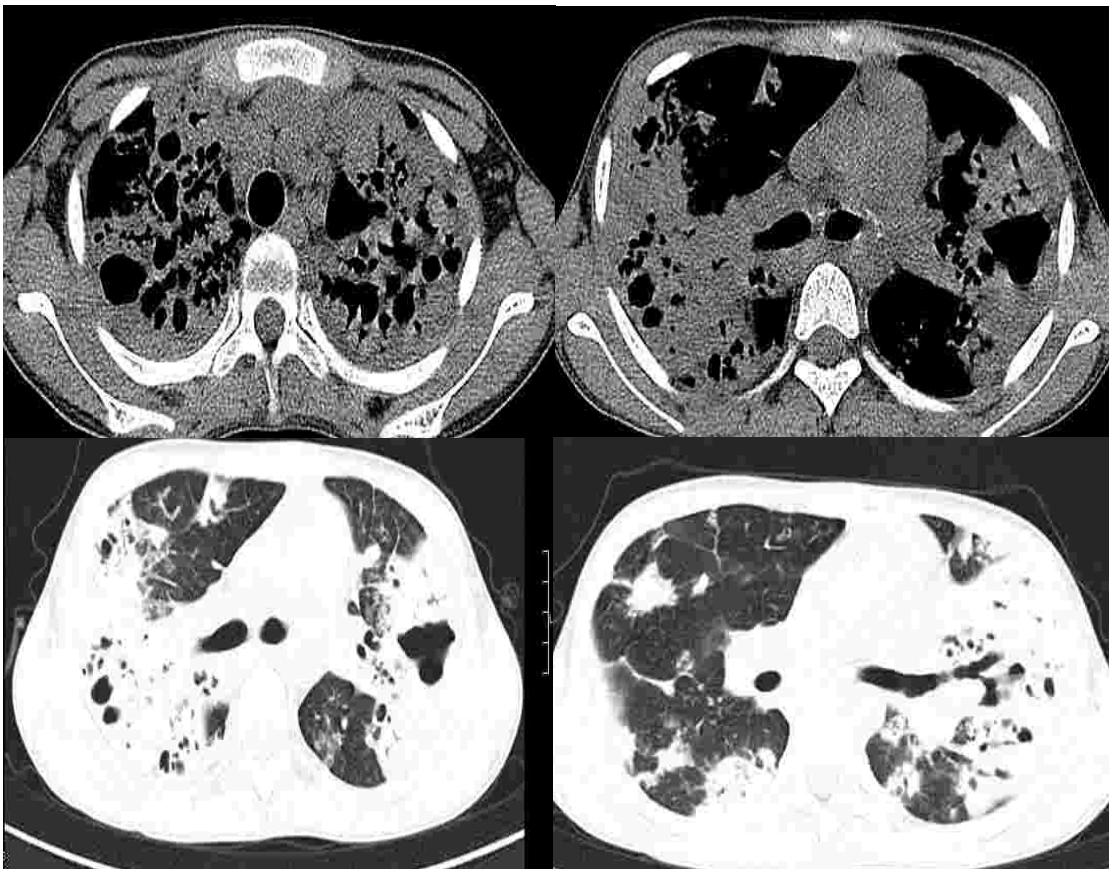


*Fig. 5.* Computed tomography of the lungs and mediastinum. Bilateral caseous pneumonia (complication of tuberculosis of the intrathoracic lymph nodes).

**Conclusions.** To summarize the analysis, it must be stated once more, that due to age-specific differences in responsiveness, complicated clinical progression of the primary tuberculosis complex occurred more often in adolescents and infants, manifesting as a disease with bronchopulmonary involvement, accompanied by a generalization of the process onto other organs and systems. In preschool and junior school age, an unfavorable clinical progression of tuberculosis was a rare exclusion and occurred predominantly in the form of a lymphogenous seeding.

**References:**

1. Rabukhin, A.E., Shchebanova, FB. (Eds.). Rukovodstvo po tuberkulezu [Tuberculosis handbook]. Moscow; 1959. P. 165-217.

2. Aksyonova, V.A. (Ed.). Tuberkulez u detey i podrostkov [Tuberculosis in children and adolescents]. Moscow; 2007. P. 136-160.

3. Driver C., Luallen J., Good W. [et al.] Tuberculosis in children younger than five years old / C. Driver, J. Luallen, W. Good [et al.] // Ped.Inf. Dis.J. – 1995. – Vol. 14, – № 2. – P. 112-117.

4. Lotte A., Noufflard H., Debra R., Brissaut H.E. The treatment of primary tuberculosis in childhood / A. Lotte, H. Noufflard, R. Debra, H.E. Brissaut // Pediatrics. –1960. – Vol. 26. – № 4. P. 641-653.

**The authors**

Shepeleva Larisa Petrovna, Head of the Radiologic Diagnostics Department, 'Phthisiatry' Research & Practice Center, PhD (Medicine)
Address: 677015, Sakha Republic (Yakutia), Yakutsk, 93 Petr Alexeev St., phone: +7(4112)35-03-25, fax: +7(4112)47-50-80, email: shepelevalp@mail.ru

Nikiforova Nina Afanasievna, radiologist of the Radiologic Diagnostics Department, 'Phthisiatry' Research & Practice Center
Address: 677015, Sakha Republic (Yakutia), Yakutsk, 93 Petr Alexeev St., phone: +7(4112)35-03-25, fax: +7(4112)47-50-80, email: nikiada@mail.ru