Clinical experience of digital chest tomosynthesis in the emergency department

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Aims and objectives

What's changing if the X-ray system will be equipped by digital tomosynthesis (DTS) in the emergency department?
Methods and materials

There were examined 158 patients aged 18 to 89 years admitted to the emergency department of City Clinical Hospital in Moscow with a variety of complaints. All patients were underwent digital chest radiography (CXR) and DTS. Multi-detectors computed tomography (MDCT) was carried out for more accurate nature of the pathological changes in 74 cases. Qualitative characteristics were analyzed by Chi-squared and Fisher’s exact test. To assess the importance of radiological methods of chest investigation was determined parametric index.
Results

According to the results of CXR all patients were allocated to five groups: nodules (n=36; 22.8%), lung consolidation (n=35; 22.2%), dissemination (n=30; 18.9%), cavities (n=29; 18.4%) and skeletal thorax injury (n=28; 17.7%).

In the first group nodules were confirmed in 25 (69.4%) patients, while in 10 (27.7%) - noted pseudolesions. #hanged vascular pattern (n = 2, 20%), fibrosis (n = 2, 20%), calcification 1st rib at the transition to its part of the cartilage (n = 2, 20%), soft tissue mass (n = 2, 20%), the consolidated rib fracture (n = 1, 10%) and infiltrative changes in lung tissue (n = 1, 10%) was taken for pathology (Fig. 1,2).

After the TS further identify another 23 nodules, signs of a fibrosis (n = 14; 38.9%), calcified intrathoracic lymph nodes (n = 8; 22.2%), calcified areas in the lung parenchyma (n = 6, 16.7%), signs of aortic atherosclerosis (n = 4; 11.1%), lung bulla (n = 1, 2.8%), the cavity (n = 1, 2.8 %) small focal dissemination (n = 1, 2.8%) and Riegler's symptom (n = 1, 2.8%). After MDCT in 8 (88.9%) cases confirmed the presence of 23 nodules and 2 pseudolesions, 10 nodules were detected that not visualized under CXR and DTS.

In the second group lung consolidation was confirmed in 29 (82.6%) cases after the TS, in 5 (17.2%) of them were able to clarify the segmental localization of the pathological process, and in 4 (13.8%) - the structure of consolidation. However, in 6 (17.4%) patients lung consolidation is not observed. This is primarily associated with the presence of summation effect on standard radiographs. The vascular pattern (66%), fibrosis (17%) and their combination (17%) were taken for consolidation.

On the background of lung consolidation there were cavities (n = 5; 14.3%), "air bronhogram" symptom (n = 7, 20%), fibrosis in the lung parenchyma (n = 8; 22.9%), and small nodules and symptom of "bronchial amputation" (n = 3; 10.3%) (Fig. 3).

After MDCT lung consolidation was confirmed in 87.5% whereas in 2 (12.5%) - excluded it. False-negative results were associated with the presence of artefacts from breathing in the tomograms. In all cases, the missing changes were localized in epiphrenic areas.

In the third group with ling dissemination pathological changes were confirmed in (96.7%) patients by DTS. However, in one case, pathology was excluded - it was local fibrosis. Also there were visualized signs of bronchiectasis, atherosclerosis of the aortic arch (12.5%), a symptom of "air bronhogram" (4.2%).

After MDCT all changes were confirmed. Additional information were signs of bronchiolitis, areas of "ground glass opacities" and intrathoracic lymphadenopathy (25%).
In the group of patients with cavities after DTS the changes are confirmed in all cases, at the same time in 13 (44,8%) patients more numbers of cavities were detected on DTS than on CXR.

By the DTS addition revealed signs of dissemination, "air bronchography" symptom and fibrosis (n = 6; 20,7%), lesions (n = 3; 10,3%) and consolidated rib fractures (n = 2, 6,9%). In 2 (6,7%) cases there were able to determine segmental bronchus, which came to the cavity (draining bronchus) (Fig. 4).

After MDCT cavities in lung tissue were confirmed in 90,9% patients, while one patient exclude the presence of pathplpgical process.

In the last group according to the results of the DTS changes confirmed in 92,9% of cases. In 2 (7,1%) cases revealed ribs fractures, that not visualize previously. On digital tomograms rib fractures on the mid-axillary line wasn't visualized, probably by reducing the spatial resolution in this area. For example, in one case the damage clearly identified on CXR in additional oblique projections, than on DTS (Fig. 5).

In one case artifacts from the metal were detected (Fig. 6).

The sensitivity, specificity, accuracy of DTS (77%, 57%, 71%) was superior to the CXR (67%, 46%, 58%) (p<0,05). Indicator general parametric index MSCT (70,2) significantly exceeds the corresponding figure in the CXR (47,4) and DTS (50,4).
Fig. 1: Frontal CXR, DTS and axial MDCT. On CXR suspicious lesions visualized (yellow arrow). Local and linear fibrosis detected on DTS and MDCT.


Fig. 2: Frontal CXR and DTS. Extrapulmonary mass detected on DTS.

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**Fig. 3:** Frontal CXR and DTS. On digital tomogram detected "air bronchogram" symptom.

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**Fig. 4:** Frontal CXR, DTS and MDCT scan. Draining bronchus detected on DTS and MDCT.

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Fig. 5: On DTS rib fractures on the mid-axillary line wasn't visualized (red circle). Rib fractures clearly identified on CXR in additional oblique projections (arrows).

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Fig. 6: Frontal DTS. Artifacts from the metal were detected.

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Conclusion

DTS can be used in the emergency department for clarification, confirmation or exclusion of pathological changes revealed by CXR and in some cases its allowing to refuse the MSCT. The major limitations of DTS is the presence of artifacts from respiration and from the metal.
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References


