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Radiological diagnostics of pleura and mediastinum invasion in lung cancer patients

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The purpose of this study was to analyse a correlation among lung cancer morphology, growth type, localisation and pleura as well as mediastinal invasion.

Materials and methods. Data on 372 patients have been analysed. Mediastinal invasion was histologically confirmed in 128 (34.4%) patients. Aorta invasion was confirmed in 21 (5.6%), vena cava superior in 11 (2.9%), pericardium in 55 (14.8%), esophagus in 7 (1.9%), pleural involvement in 54 (14.5%), pleural fluid in 51 (13.7%) patients. Chest radiography was performed for all patients, 68 patients underwent chest CT examination.

Results. The probability of mediastinal invasion increases in the cases of squamous cell, undifferentiated and small cell carcinomas ($p < 0.05$). Pleuritis and pleural involvement have been found predominantly in adenocarcinomas.

Using CT findings of possible mediastinal invasion (a 3 cm or more mass contact with the mediastinum, the angle of contact with the aorta more than 90°, obliteration of the fat plane between mass and mediastinal structures), the sensitivity of CT identifying mediastinal invasion increases.

Conclusions. Mediastinal and pleural invasion depends on the morphology of cancer. Mediastinal invasion is more common in squamous, undifferentiated and small cell carcinomas. Adenocarcinomas predominantly spread to the pleura and cause pleural fluid accumulation. CT findings such as cancer mass contact with the mediastinum more than 3 cm and the angle of contact with the aorta more than 90° raise CT sensitivity while evaluating mediastinal involvement. These CT findings could also reflect the operability of a process.

Key words: lung cancer, morphology, pleural and mediastinal invasion, operability

INTRODUCTION

At the time of presentation, 70% of lung cancer patients have advanced locoregional or metastatic involvement, which is considered inoperable (1). An important aim of preoperative staging is to select patients with a localized disease, who may benefit from surgery, avoiding unnecessary thoracotomy in others with unresectable tumours (2).

TNM classification for bronchogenic carcinoma distinguishes between T3 involvement of mediastinal structures, which may be resected (mediastinal pleura or pericardium, mediastinal fat) and T4 tumors, which invade the heart, great vessels, trachea, esophagus, and are usually not resectable (1–4). The involvement of parietal pleura by a direct tumour extension is classified as T3 and is respectable. CT has shown disparate results in evaluating chest wall invasion by tumour. The only highly accurate CT finding with a 100% positive predictive value for chest wall invasion was bone destruction with or without soft tissue mass extending into the chest wall. There are other CT findings described in the literature, such as pleural thickening, the angle between mass and chest wall that are less accurate indicators of malignant invasion (1, 2). Pleural effusion caused by pleural metastases (T4, unresectable) should be differentiated from a benign effusion. In CT scans, malignant effusion is described as soft tissue nodularity along the pleural surfaces, accompanying the effusion (2).

In a study with 80 patients, Glazer (3) represents CT criteria for probable mediastinal invasion in lung

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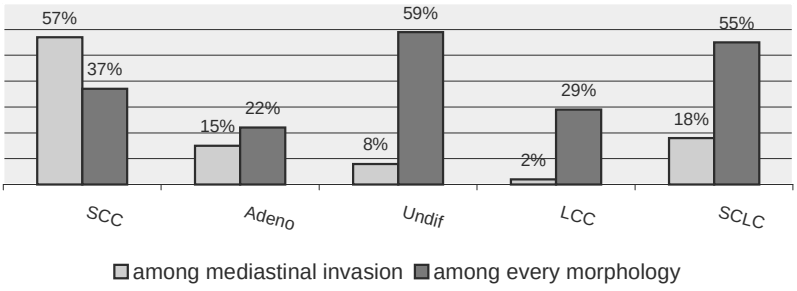


Fig. 1. Correlation of lung cancer morphology with direct mediastinal invasion

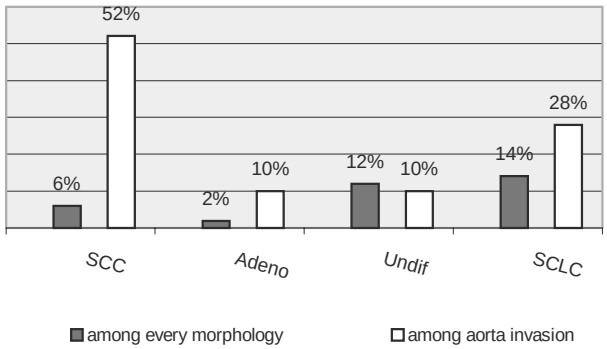


Fig. 2. Correlation of aorta invasion with lung cancer morphology

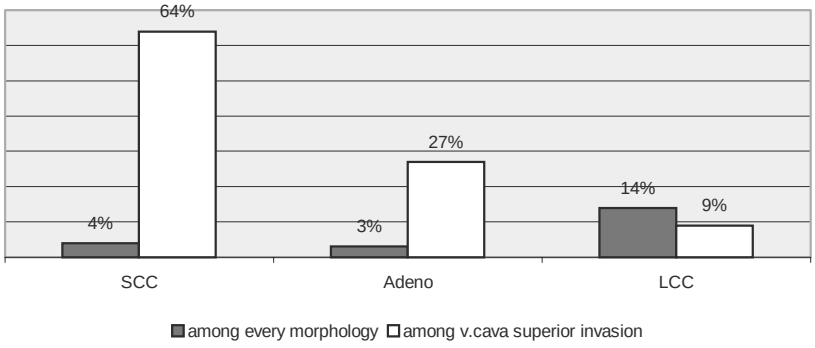


Fig. 3. Correlation of vena cava superior invasion with lung cancer morphology

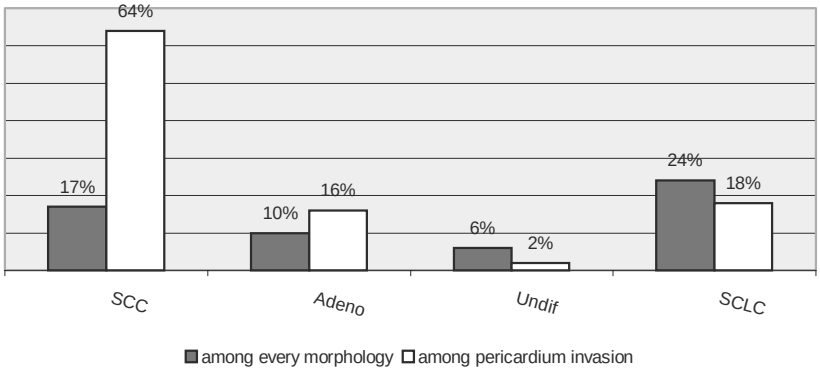


Fig. 4. Correlation of pericardium invasion with lung cancer morphology

cancer patients, such as mass contact with the mediastinum more than 3 cm and the angle of contact with the descending aorta more than 90°. However, these criteria were not reliable signs of either invasion or respectability.

Patient survival rate after T3 surgical treatment is 36%, while it reaches only 12% in patients with T4 lesions (1). The operability and survival rate in patients with mediastinal invasion are considerably worse than in patients with chest wall and ribs involvement (5).

Not only the stage but also lung cancer morphology determines postoperative survival: Martini et al. (5) state that in patients with T3 lesions the postoperative survival rate is 23% in adenocarcinomas and 12% in squamous cell carcinomas. Kirsch and Sloan report that the postoperative survival rate reaches 34% in squamous cell carcinomas and 12% in adenocarcinomas (6). Less attention in the literature is paid to the influence of morphology on cancer intrathoracic spread differences, so in our work we wanted to analyse possible correlations between lung cancer morphology and intrathoracic spread.

The purpose of the work was to analyse a correlation between lung cancer morphology, growth type, localisation as well as pleural and mediastinal invasion.

One of the goals was to estimate the sensitivity and specificity of radiologic diagnostic methods while evaluating lung cancer invasion to pleura and mediastinum.

MATERIALS AND METHODS

Data on 372 patients operated on for lung cancer were analysed. Mediastinal direct invasion (T3, T4) was confirmed in 128 (34.4%), invasion of aorta in 21(5,6%), vena cava superior in 11 (2.9%), pericardium in 55 (14.8%), esophagus in 7 (1.9%) of these patients. Pleural fluid was confirmed in 51 patients, pleural metastases in 28 patients, direct pleural invasion in 26 patients, rib destruction in 17 and thoracic wall lesion in 20 patients.

Anterior and lateral chest radiograms were performed for all patients and CT for 68 patients.

All lung cancers according to growth type were divided into central, peripheral and disseminated. According to morphological classification, they were divided into the main groups: 200 (53.7%) squamous cell carcinomas (SCC), 90 (24.2%) adenocarcinomas, 5(1.3%) bronchoalveolar carcinomas, 17(4.6%) undifferentiated carcinomas, 7 (1,9%)

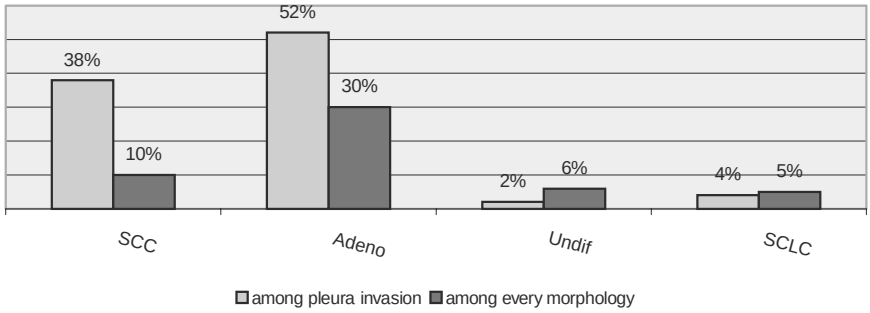


Fig. 5. Correlation between pleura involvement and lung cancer morphology

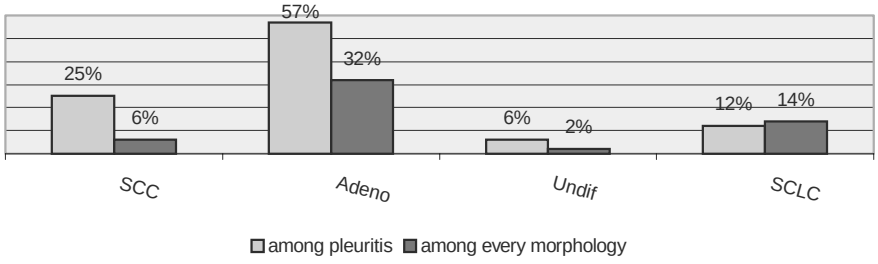
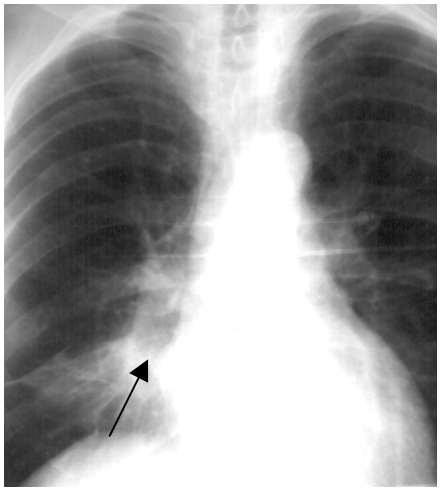
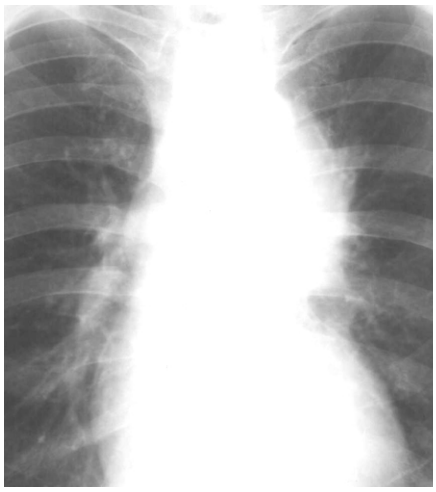


Fig. 6. Correlation between pleural fluid and lung cancer morphology



Picture 1. Mediastinal pleura adhesion is observed near the heart shadow. Invasion of pericardium was confirmed



Picture 2. Tight contact between cancer mass and mediastinum is observed. Inoperable lesion of mediastinum and aorta was confirmed

Picture 3. More than 3 cm cancer mass contact with mediastinum is observed. Inoperable mediastinal invasion was confirmed

large cell carcinomas (LCC), 42 (11.3%) small cell carcinomas (SCLC), 3 (0.8%) adenosmall cell carcinomas and 8 (2.2%) adenosquamous carcinomas.

All the data were processed with Progfreq and Proc logistic statistical programs.

RESULTS

The diagrams represent data on lung cancer morphology correlation with lung cancer intrathoracic invasion.

A statistically based correlation between lung cancer mediastinal invasion and squamous cell morphology were estimated ($p = 0.0003$); undifferentiated and small cell carcinomas predominated amongst mediastinal invasion ($p < 0.05$).

Squamous cell morphology predominated in aorta invasion (52%), but it was common amongst undifferentiated (12%) and small cell carcinomas (14%).

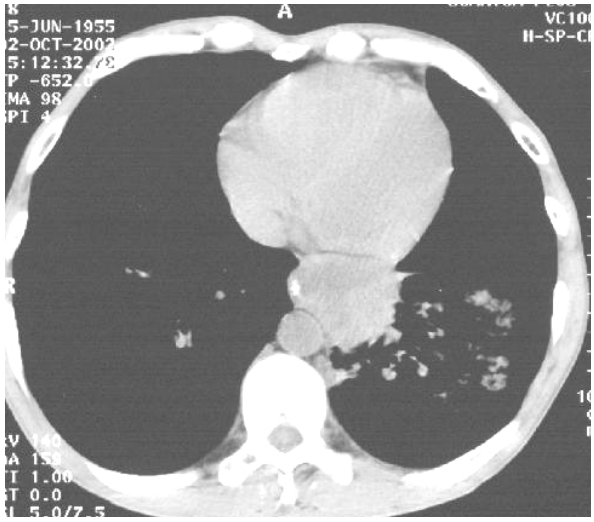
Amongst vena cava superior invasion, squamous cell carcinomas were more common. A statistically based correlation was established between vena cava superior invasion and cancer localization in the right upper lung lobe ($p = 0.0008$).

Pericardium invasion was more common in squamous cell carcinomas (64% among pericardium invasion and 17% among squamous cell morphology), but was also common among small cell carcinomas (24%).

Pleural invasion was present in adenocarcinomas ($p = 0.0003$), both amongst pleural invasion and in different morphology groups.

Pleural fluid was more often confirmed in adenocarcinomas ($p < 0.0001$).

A statistically based correlation between central carcinoma growth and mediastinum involvement (ð < 0.001), esophagus



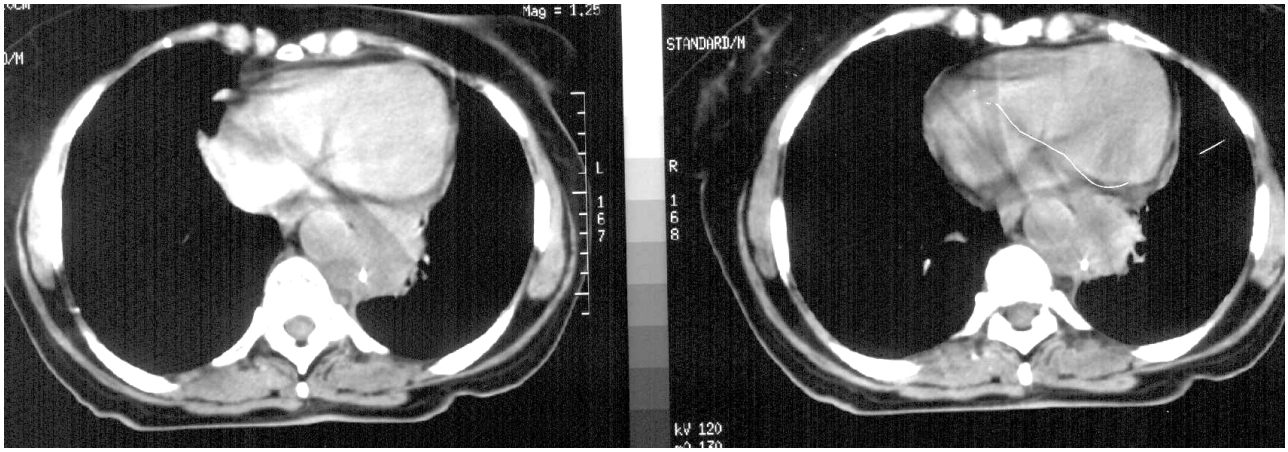
Picture 4. More than 3 cm cancer mass contact with mediastinum is observed. Although a dark demarcation line is seen between the mass and the pericardium, pericardial and mediastinal inoperable involvement was determined

(p = 0.0437) and pericardium (p = 0.0248) was established. Peripheral carcinomas more often involved parietal pleura (p < 0.0001) and chest wall (p = 0.008).

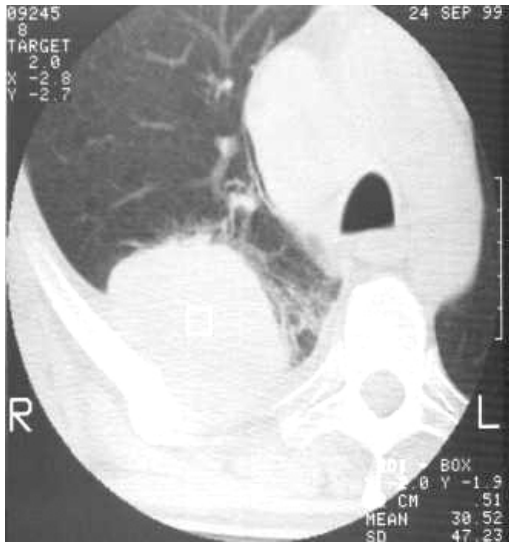
DISCUSSION

Conventional radiography is not adequate for detecting mediastinal or pleural invasion although our observations show that a right contact between cancer mass and mediastinum shadow indicate mediastinal invasion (Pictures 1, 2). The sensitivity of the radiographic method rose form 4% to 16%.

While evaluating mediastinal invasion signs on CT scans, such as mediastinal fat obliteration, mass effect or deformity of mediastinal structures, its sensitivity was 33% specificity 97%. Using CT finding such as cancer mass contact with mediastinum more than 3 cm (3, 8), the sensitivity of CT rose up to 57% and the specificity was 94%.



Picture 5. More than 90° of mass contact with aorta is observed. Inoperable lung cancer with aorta invasion was confirmed



Picture 6. Peripheral carcinoma with chest wall invasion and bone destruction is observed. Mass contact with pleura is more than 3 cm

CT sensitivity determining descending aorta involvement was 14% and specificity 100%. In cases where the mass abutted the descending aorta wall, with the total aortic circumference as 360°, the contact was graded as less than 90° or 90° and greater. Descending aorta involvement was suspected when the angle of contact with the aorta was more than 90° (3). Using this finding the sensitivity of CT was 57% and the specificity 95%.

According to different authors, CT sensitivity evaluating lung cancer mediastinal invasion may range between 51–100% and specificity from 60 to 100% (1, 2, 6, 7).

Only 15 patients (12%) from 128 with mediastinal invasion underwent complete resections (9 of them had a T3 process). All the patients with CT findings such as mass contact with the mediastinum more than 3 cm and the angle of contact with the descending aorta more than 90° had technically unresectable masses. Consequently, these findings could

be used also for process operability prevision, although Glazer (3) states that these findings not necessarily indicate an inoperable process.

Evaluating pleural fluid, CT sensitivity was 82.35% and specificity 100%; the sensitivity and specificity of the radiographic method was 47% and 100%, respectively. Metastatic pleura involvement (pleural carcinosis) was not diagnosed on radiographs or CT. Chest sonography may be of great value in such cases (2). Direct pleural invasion is unquestionable in the case of bone destruction. If the mass contact with the pleura is more than 3 cm, parietal pleural invasion may be suspected (1, 2).

A statistically based correlation ($p < 0.05$) between mediastinal invasion and cancer localization in the lung depended on topographically closest mediastinal organs, for example, the between pericardium involvement and right middle lobe cancer, v. cava superior involvement and right upper lobe cancer localization, etc.

CONCLUSIONS

1. Mediastinal and pleural invasions depend on the morphology of cancer. Mediastinal invasion is more common in cases of squamous, undifferentiated and small cell carcinomas. Adenocarcinomas predominantly spread to the pleura and cause pleural fluid collection.

2. Central lung carcinomas tend to invade mediastinal organs more often than do peripheral carcinomas.

3. CT findings such as cancer mass contact with the mediastinum more than 3 cm and the angle of contact with the aorta more than 90° raises CT sensitivity while evaluating mediastinal involvement.

4. These CT findings could also reflect process operability.

5. A light contact between the cancer mass and the mediastinum shadow in conventional radiographs may indicate mediastinal invasion.

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References

1. Pass Harvey I, Mitchell James B, Johnson David H. Lung Cancer: Principles and practice. Lippincott-Raven Publishers, Philadelphia, 1996: 437–70.
2. Vansteenkiste J, Bittner R, Izbicki J et al. Evolving techniques in the staging of lung cancer. Eur Respir Rev 2002; 12: 141–55.
3. Glazer Harvey S, Kaiser LR, Anderson DJ et al. Indeterminate mediastinal invasion in bronchogenic carcinoma: CT evaluation. Radiology 1989; 173: 37–42.
4. Macchiarini P, Chapelier AR, Monnet I et al. Extended operations after induction therapy for stage IIIB (T4) non-small call lung cancer. Ann Thorac Surg 1994; 57: 966–73.
5. Martini N, Yellin A, Ginsberg R et al. Management of non-small cell lung cancer with direct mediastinal involvement. Ann Thorac Surg. 1994; 58: 1447–51.
6. Slawson RG. Mediastinal lung cancer: answers and question. Southern Medical Journal 1994; 87(6): 646–52.
7. Àêîïîâ ÀË, Áîáðîâ ÅÈ. Ýôôåêòèâíîñòü êîìïüþòåðíîé òîìîãðàôèè ïðè ìåñòíî-ðàñïðîñòðàíåííîì ðåöåäèâíîì ðàêå ëåãêîãî. Âîïðîñû îíêîëîãèè 2001; 47(5): 580–3.
8. Lee JKT, Sagel SS, Stanley Robert J. Computed Body Tomography. Raven Press. New York 1983; 55–130: 535–46.

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PLEUROS IR TARPUPLAUÈIO PAÞEIDIMO RADIOLOGINË DIAGNOSTIKA SERGANT PLAUÈIØ VËÞIU

Santrauka

Tyrimo **tikslas** buvo nustatyti koreliacijà tarp plauèiø vëþio morfologinio tipo ir iðplitimo krûtinës làstoje poþymiø.

Medþiaga ir metodai. Iðanalizuoti 372 pacientø, operuotø dël plauèiø vëþio, duomenys. Tarpuplauèio ir jo organø paþeidimas nustatytas 128 (34,4%) pacientams, pleuros paþeidimas – 54 (14,5%) pacientams, pleuritas – 51 (13,7%) pacientui. Aortos peraugimas nustatytas 21 (5,6%), virðutinës tuðèiosios venos paþeidimas – 11 (2,9%), perikardo – 55 (14,8%), stemplës – 7 (1,9%) pacientams. Visiems pacientams prieð operacijà atliktos krûtinës làstos rentgenogramos, 68 pacientams atliktos krûtinës làstos kompiuterinës tomogramos (KT).

Rezultatai. Tarpuplauèio paþeidimas buvo patikimai daþnesnis nediferencijuotø, smulkialàsteliniø ir plokðèialàsteliniø karcinomø atveju. Tarp adenokarcinomø vyravo pleuros vëþinis paþeidimas ir pleuritas ($p < 0,05$). KT metodo jautrumas ir specifiðkumas nustatant plauèiø vëþio iðplitimà á tarpuplauèio organus padidëja naudojant ðiuos vertinimo kriterijus: darinio kontaktas su tarpuplauèiu didesnis nei 3 cm, darinio kontaktas su nusileidþianèiàja aorta sudaro daugiau nei 90° jos apskritimo.

Iðvados. Tarpuplauèio ir pleuros paþeidimas priklauso nuo plauèiø vëþio morfologinio tipo. Tarpuplauèio paþeidimas bûdingesnis nediferencijuotoms, smulkialàstelinëms ir plokðèialàstelinëms karcinomoms. Adenokarcinomoms labiau bûdingas pleuros paþeidimas bei pleuritas. KT stebint didesná nei 3 cm darinio kontaktà su tarpuplauèiu ir kontaktà su aorta, sudarantá daugiau nei 90° jos apskritimo, galima átarti ðiø struktûrø peraugimà.

Raktaþodþiai: plauèiø vëþys, pleuros, tarpuplauèio paþeidimas