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Radiologic Evaluation of Malignant Pleural and Peritoneal Mesothelioma

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1. Introduction

Malignant mesothelioma is an asbestos-associated malignancy arising from the mesothelial cells of the pleural and peritoneal cavities, as well as the pericardium and the tunica vaginalis.

Mesothelioma usually presents in the fifth to seventh decades, and 70-80 % of cases occur in men (Moore et al., 2008). Malignant pleural mesothelioma (MPM) is the most widely form of mesothelioma. Patients frequently present with dyspnea, chest pain, cough, and weight loss (Moore et al., 2008, Wang et al., 2004). Although most of the mesotheliomas cover the pleural surface, approximately 35% arise only from peritoneum. Patients with malignant peritoneal mesothelioma may present with abdominal pain, distention, anorexia, and weight loss (Park et al., 2008).

Radiologic modalities play a crucial role in the evaluation of malignant mesothelioma. Computed tomography is the primary imaging method used for the diagnosis and the staging of malignant mesothelioma, but also for guiding biopsy for tissue diagnosis. Magnetic resonans imaging (MRI) is useful for detection of extension of disease, especially to the chest wall and diaphragm (Moore et al., 2008, Wang et al., 2004). In this article we review radiologic findings of malignant pleural and peritoneal mesothelioma with our patient archives. We also wants to give some information about differential diagnosis malignant pleural and peritoneal mesothelioma.

2. Material and methods

We scanned our patient archive of mesothelioma between 2008-2011 years. We accepted patients who had CT or MRI at their initial diagnosis. We have had 135 patient who suffered from mesothelioma but only 35 patient had CT or MRI at the time of diagnosis. Twenty seven of them were pleural mesothelioma, and 8 of them peritoneal mesothelioma.

3. Results

In pleural mesothelioma group, there were 10 women (37%) and 17 men (63%). The avarage age was 55.14±12.47 (min: 29 - max: 87). We found pleural effusion in 23 patients

(85.12%), pleural thickening in 27 patients (100%) (Fig. 1.,2.), pleural calcification in 11 patients (40.7%) (Fig.1.), lymphadenopathy in 11 patients (40.7%) (Fig. 1., 4., 6.), direct extension to mediastinal organs in 10 patients (37%), pericardial effusion in 6 patients (22.2%) (Fig. 5.), extension of chest wall in 7 patients (25.9%), extension of diaphragm in 5 patients (18.5%), thickening of interlober fissur in 11 patients (47.7%)(Fig. 2.), reduction in thoracic volume in 8 patients (29.6%)(Fig. 1.), brain metastases in only one patient (3.7%), pulmonary metastases in 2 patients (%7.4),(Fig. 3) hepatic metastases in 2 patients (7.4%), (Fig. 9) (Table1).

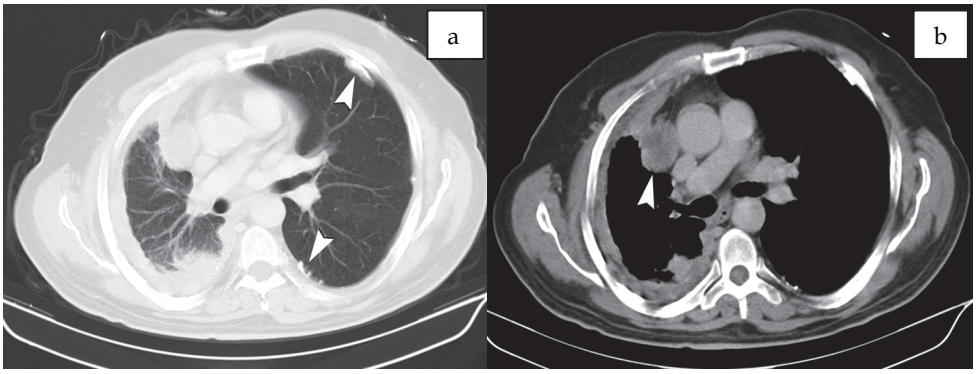


Fig. 1. Axial contrast enhanced CT parenchymal (a.) and mediastinal sections (b.) shows nodular, irregular and circumferantial right sided pleural thickening in 55 year-old man. Note that contracted right hemithorax and anterior mediastinal lymph node (arrow head). We can see pleural calcification on left sided pleural surface (arrow head).

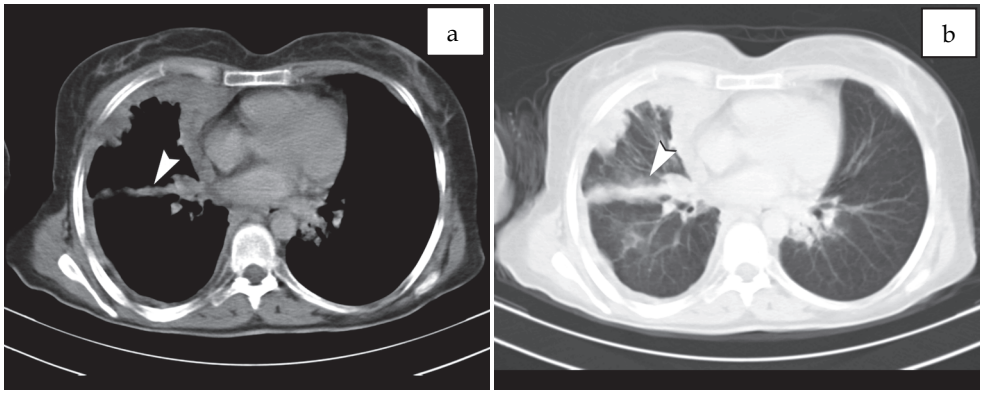


Fig. 2. Axial contrast enhanced CT mediastinal (a.) and parenchymal sections (b.) shows right sided irregular pleural thickening and right major fissur involvement (arrow head).

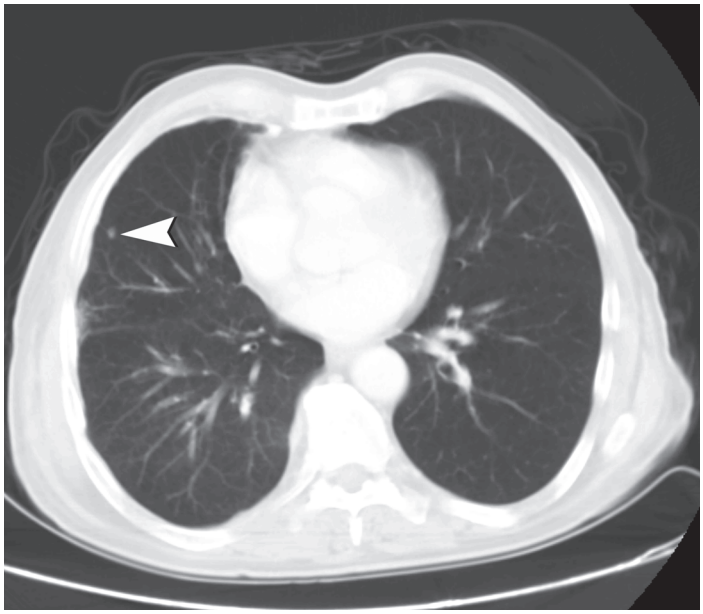


Fig. 3. Axial non- contrast enhanced CT a milimetric parenchymal nodul in right middle lobe (arrow head).

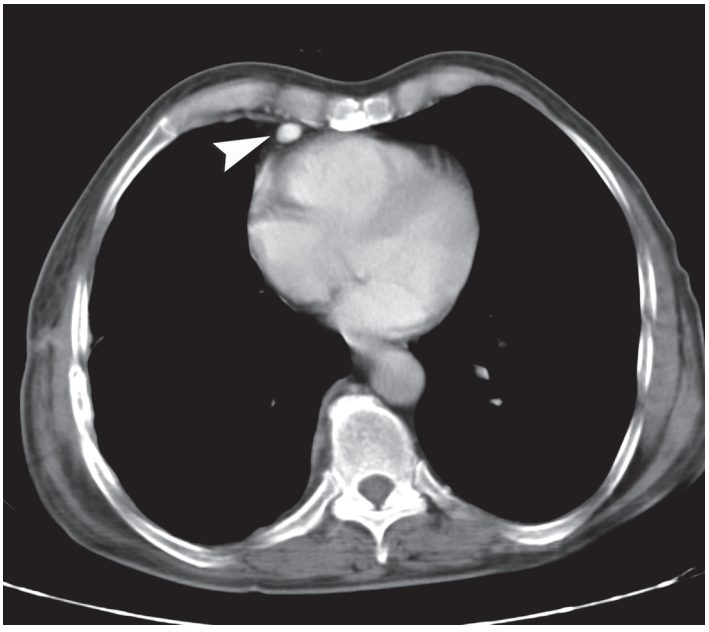


Fig. 4. Axial contrast enhanced CT show 1 cm paracardiac lymphadenopathy in 65 year old man with MPM.

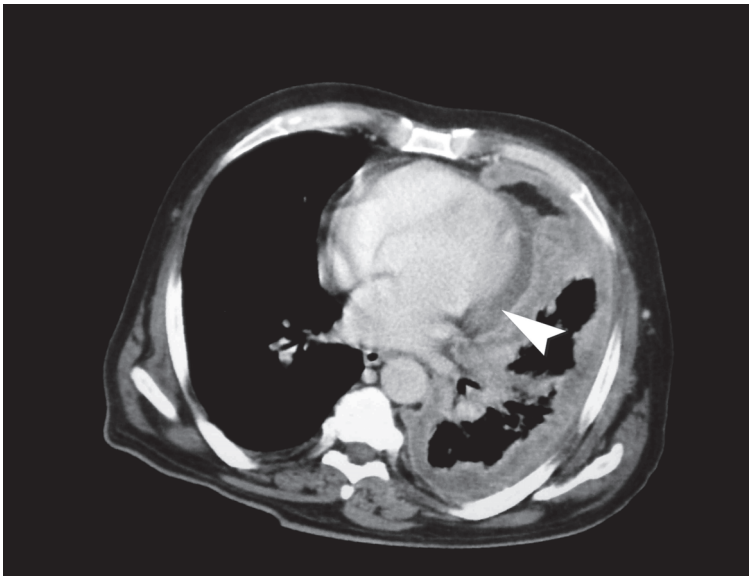


Fig. 5. Axial contrast enhanced CT shows pericardial invasion and pericardial effusion.

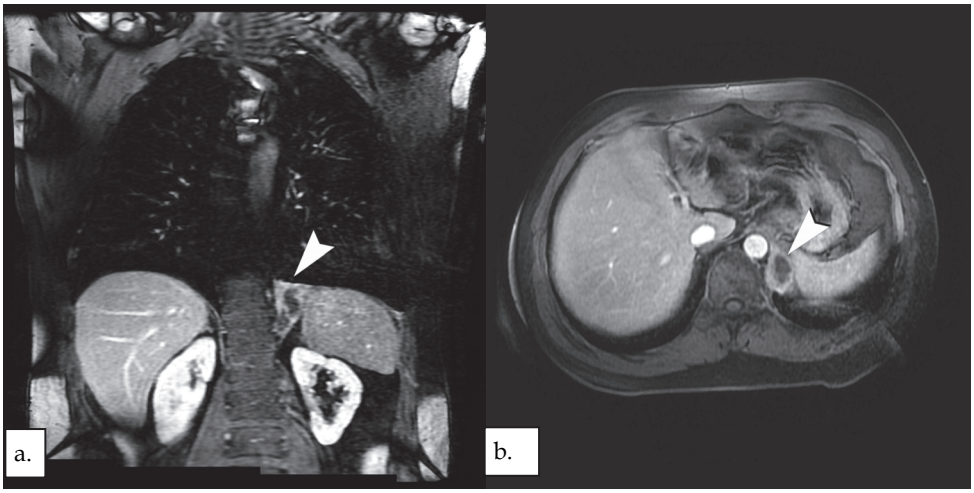


Fig. 6. Coronal (a) and axial (b) postcontrast T1 weighted images show a solitary mass with central necrosis into left retrocrural space at a patient with malignant pleural mesothelioma.

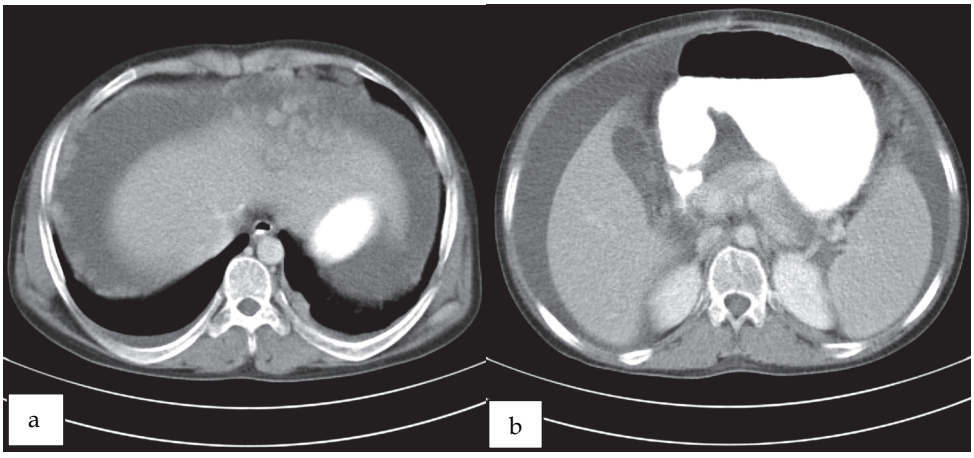
Radiologic Findings	Rates
Pleural Effusion	85.12%
Pleural Thickening	100%
Pleural Calcification	40.7%
Thickening of Interlober Fissur	47.7%
Reduction in Thoracic Volume	29.6%
Mediastinal Lymphadenopathy	40.7%
Direct Extension To Mediastinal Organs	37%
Pericardial Effusion	22.2%
Extension Of Chest Wall	25.9%
Extension Of Diaphragm	18.5%
Metastases	11.1%

Table 1. Pleural mesothelioma radiologic findings

In peritoneal mesothelioma group, the average age 60.75±10.41 (min: 42-max: 73). There were 2 female (25%) and 6 male (75%) patient. We found peritoneal irregularity and nodular thickening in 4 patients (50%)(Fig. 7a.), diffuse peritoneal thickening (omental cake) in 4 patients (50%)(Fig. 7c., 8a., b., c.), ascites in 5 patients (62.5%) (Fig. 7., 8.), extension of adject tissue in only one patient (2.5%) (Table 2).

Radiologic Findings	Rates
Peritoneal irregularity and nodular thickening	50%
Diffuse peritoneal thickening	50%
Ascites	62.5%
Extension of adject tissue	2.5%

Table 2. Malignant peritoneal mesothelioma radiologic findings



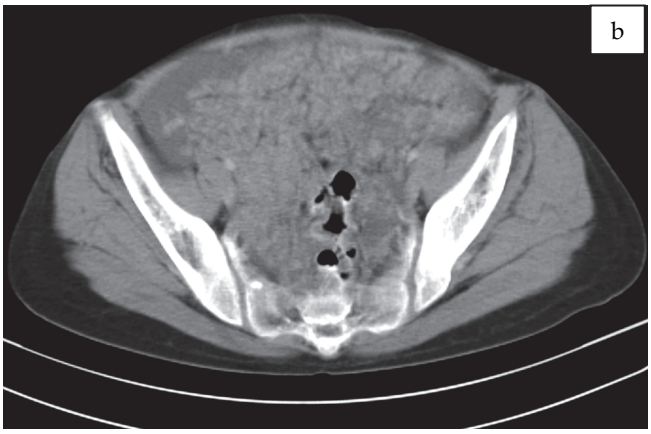


Fig. 7. Malignant peritoneal mesothelioma. a. Contrast enhanced CT scan shows nodular peritoneal thickening. b. Axial contrast enhanced CT shows perisplenic and perihepatic large amount of ascites. c. Axial contrast enhanced CT shows diffuse peritoneal thickening with omental cake.

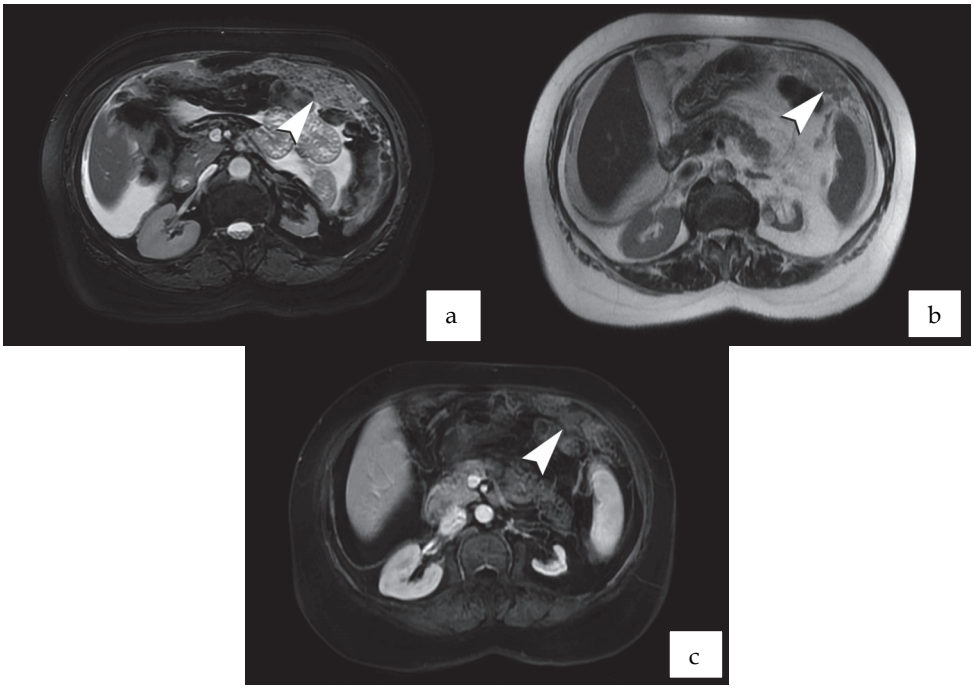


Fig. 8. Diffuse irregular thickening of parietal peritoneum with omental cake is hypointense on axial T2 Weighted images (a), hyperintense on FIESTA sequence (b), shows minimal enhancement on post-gadolinium axial T1 Weighted images (c). We can see perihepatic minimal ascites.

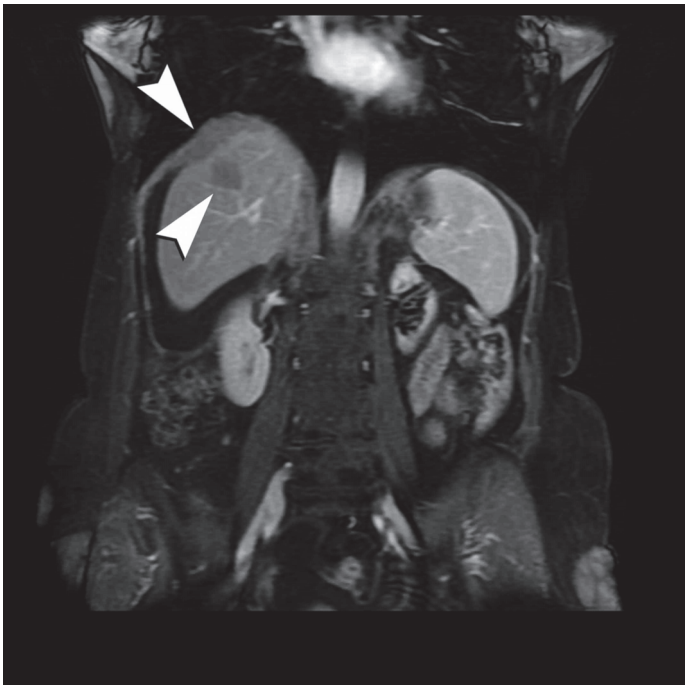


Fig. 9. Coronal post gadolinium T1 weighted image shows perihepatic focal parietal peritoneal thickening and hepatic metastases.

4. Discussion

The association of history, examination, radiology and pathology is essential in the diagnosis of mesothelioma. Radiological imaging is important for the diagnosis, staging and management of mesothelioma.

4.1 Pleural mesothelioma

Intravenous contrast-enhanced CT is the primary imaging modality for suspected malignant mesothelioma. CT can show the whole pleural surface and diaphragm. CT

findings that is seen mostly are nodular pleural thickening, unilateral pleural effusion, pleural calcification, thickening of interlobar fissur, reduction of thoracic volume (Wang et al., 2004, Ismail-Khan et al., 2006). Pleural calcification is seen approximately 20% of cases (Moore et al., 2008, Wang et al., 2004). Typically, both the visceral and parietal pleurae are involved. Malignant pleural thickening characteristically is circumferantial, nodular and > 1 cm. Also, mediastinal pleural involvement is often detected (Ismail-Khan et al., 2006). Malignant pleural mesothelioma is locally aggressive with invasion of the chest wall, mediastinum and diaphragm. Obliteration of extrapleural fat planes, invasion of intercostal muscles, displacement of ribs, and bone destruction are findings of chest wall involvement. Heart, esophagus, trachea and major vascular structures of mediastinum may be involved by tumor. Nodular pericardial thickening and pericardial effusion refers to pericardial invasion by malignant pleural mesothelioma. Obliteration of surrounding fat planes of mediastinal organs, covering of vascular structure more than 50% is a strong evidence of invasion (Moore et al., 2008, Wang et al., 2004, Miller et al., 1996, Patz et al., 1992).

Pulmonary metastases of MPM presenting as nodules and masses and, rarely, diffuse miliary nodules may be seen at CT. Chest CT may also rarely demonstrate extrathoracic spread of MPM. Metastasis to the hilar and mediastinal lymph nodes is present at autopsy in approximately 40-45% of patients with MPM (Miller et al., 1996, Patz et al., 1992, Dynes et al., 1992).

MRI screening is not used routinely in the assessment of malignant mesothelioma, however in patients with potentially resectable disease, MRI can help to provide additional staging information over and above CT. Using gadolinium enhancement, MRI can advance the identification of tumor extension into the diaphragm or chest wall. MRI also is preferred in some patients whom intravenous iodinated contrast is contraindicated.

Malignant pleural mesothelioma is typically isointense or slightly hyperintense on T1-weighted images and moderately hyperintense on T2-weighted images relative to adjacent chest wall muscle. After the gadolinium injection, MPM shows enhancement. MR imaging is superior to CT for showing invasion of the diaphragm and invasion of endothoracic fascia or a single chest wall focus (Moore et al., 2008, Miller et al., 1996, Patz et al., 1992).

The radiologic differential diagnosis includes metastatic pleural disease, pleural lymphoma, asbestos releated benign pleural disease, and tuberculous empyema. Pleural rind, nodular pleural thickening, pleural thickening greater than 1 cm, and mediastinal pleural involvement favor malignant pleural disease. Pleural calsification is usually seen in benign process. Mesothelioma can not be distinguished from metastatic pleural disease on CT. Discrimination between epithelial types of mesothelioma and metastatic adenocarcinoma requires histochemical, immunohistochemical, and ultrastructural analysis. The presence of hilar-mediastinal adenopathy may be helpful in differentiating metastases and lymphoma from mesothelioma. The radiologic criteria for unresectability are tumor encasing diaphragm, invasion of extrapleural soft tissue, infiltration, displacement, or seperation of ribs by tumor, or bone destruction (Moore et al., 2008, Dynes et al., 1992, Barreiro et al., 2006, Jeong et al., 2008).

Morphologically malignant pleural mesothelioma can be seen in three forms: epithelial, sarcomatous, and mixed. The mixed form is usually mentioned as biphasic or bimorphic. Mixed tumors are composed of both epithelial and sarcomatous components. Epithelial mesotheliomas have a better diagnosis than sarcomatous and mixed tumors so differential diagnosis is very important for determining the prognosis. Epithelial malignant mesotheliomas consist of cells that are similar to normal mesothelial cells. The cells form a tubulopapillary or trabecular pattern. Epithelial malignant mesothelioma may also show prominent secretory changes, microglandular patterns, signet cell structure, or desmoplastic responses that make these tumors difficult to differentiate from adenocarcinomas based on routine histologic analysis alone. The sarcomatous pattern of malignant mesothelioma is typically consist of closely packed spindle cells. No immunohistochemical markers are spesific for malignant mesotheliomas and so there are some immunohistochemical markers such as calretinin thrombomodulin, and cytokeratin 5/6 to differentiate from metastatic adenocarcinomas and soft tissue sarcomas that have similar to histologic appearances (Levy et al., 2008). (Fig. 10).

4.2 Peritoneal mesothelioma

Approximately 35% of all mesotheliomas arise only from the peritoneum. There are three pathologic subtypes of peritoneal mesothelioma: Malignant mesothelioma, cystic mesothelioma, or well-differentiated papillary mesothelioma. CT findings of these subtypes are different from each other (Park et al., 2008).

Malignant peritoneal mesothelioma is seen at fifth and sixth decades. Asbestos exposure is a predisposing factor. We can see two different apperance at CT. Dry apparence is characterized with peritoneal based masses and wet apparence is characterized ascites, irregular or nodular peritoneal thickening and omental mass may be seen at CT. Peritoneal carcinomatosis, serous papillary carcinoma of peritoneum, tuberculous peritonitis and peritoneal lymphomatosis should be thought in differential diagnosis. It is very difficult to do differential diagnosis by using only CT. Prominent ascites and less severe peritoneal thickening is seen in peritoneal carcinomatosis. The incidence of liver metastasis and lymphadenopathy is also higher in peritoneal carcinomatosis. Serous papillary carcinoma is found predominantly in elderly women and postmenopausal women. We must think tuberculous peritonitis if we see smooth peritoneal thickening, mesenteric lymphadenopathy with central necrosis, ascites with high attenuation, and splenomegaly at CT. Diffuse retroperitoneal and mesenteric lympadenopathy and the lack of omental involvement may misgive about lymphomatosis (Park et al., 2008, Levy et al., 2008).

Cystic mesothelioma is a benign tumor that is occur mainly in young to middle-aged women. It is usually associated with a history of previous abdominal surgery or pelvic inflammatory disease. Relationship between asbestos exposure and cystic mesothelioma has not been reported. Involvement of pelvic region is typical. Hormonal therapy is usually useful for treatment of cystic mesothelioma. Multilocular cystic mass, multiple unilocular cystic thin-walled cysts, or a unilocular cystic mass. Cystic lymphangioma, cystic epithelial neoplasms of the ovaries and endometriosis is thought in the differantial diagnosis. Cystic

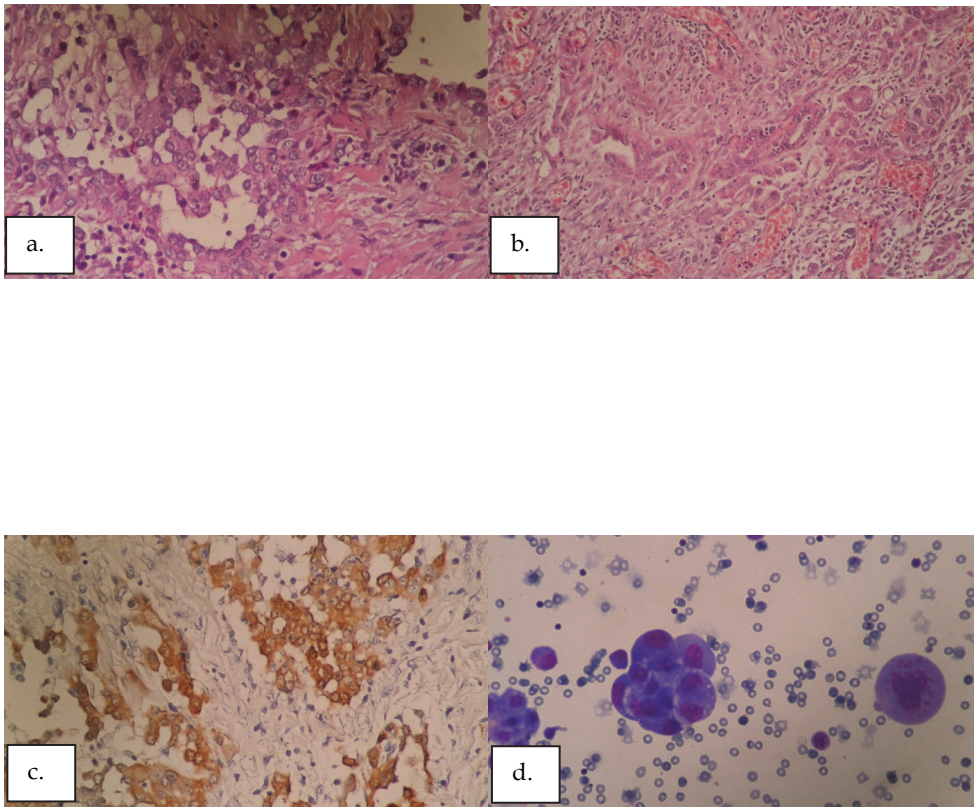


Fig. 10. a. Malignant mesothelioma that shows papillary formation and desmoplastic stromal reaction, b. Biphasic malignant mesothelioma which consists of epitheloid and spindle cells, c. Malignant mesothelioma cells that show immunreactive with calretinen, d. Pleomorphic mesothelial cells (May Gruwald Giemsa)

lymphangioma is seen in younger patients than cystic mesothelioma. It does not show regional predilection. Thick-walled cysts, thick internal septa, and high-attenuation internal debris favor the diagnosis of endometriosis. Well-differentiated papillary mesotheliomas is found reproductive-age women. Peritoneal thickening, multiple peritoneal nodules, omental infiltration and ascites may be seen at CT. It should be thought as the same disease that is thought in malignant peritoneal mesothelioma in differential diagnosis (Park et al., 2008, Levy et al., 2008., Pickhardt et al., 2005).

5. Conclusion

Malignant mesothelioma can be difficult to diagnose. Neither CT scanning nor MRI provides an unequivocal diagnosis of mesothelioma; tissue biopsy is required for the definitive diagnosis (Wang et al., 2004, Miller et al., 1996, Patz et al., 1992, Pickhardt et al., 2005, Zahid I et al. 2011).

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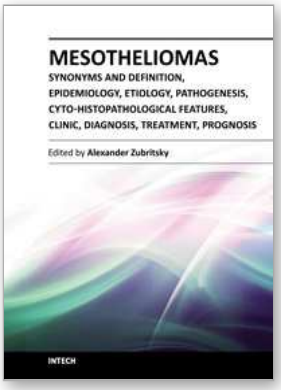

Mesotheliomas - Synonyms and Definition, Epidemiology, Etiology, Pathogenesis, Cyto-Histopathological Features, Clinic, Diagnosis, Treatment, Prognosis

Edited by Dr Alexander Zubritsky

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Mesotheliomas are mysterious mesothelial tumors in that they are relatively rare, difficult to diagnose, with a large number of synonyms, and the etiology and pathogenesis of the disease are still not fully disclosed. This problem attracts the attention of various specialists in the field of medicine and biology every year. In recent years there has been a significant increase of mesothelioma morbidity in most of the countries, due to the further industrialization of society. In this regard, this book has been published with the participation of an international group of experts with rich experience from around the world . The book consists of 14 chapters containing the most advanced achievements of all aspects of the various types of mesotheliomas, both in humans and domestic animals, at a high methodological level. This book is intended for biologists and all health care workers, mostly oncologists of different profiles, as well as students of medical educational institutions engaged or even just interested in the problems of mesotheliomas.

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