The Diagnostic Value of Pleural Fluid Cytology in Benign and Malignant Pleural Effusions

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Abstract

In developing countries, where investigations and health facilities are inadequate and cost of treatment is unaffordable, cytological examination of body fluids is considered a cheap, rapid, and highly effective tool in identification of the etiology of effusion with prediction of the underlying disease. Cytological examination can detect malignant cells in effusions and sometimes it's superior to biopsy in detecting serosal malignancy. Good clinical history, history of asbestos exposure, absence of other malignancy elsewhere in the body and radiologic findings are very important aids in confirmation of cytological diagnosis of malignancy. Sometimes, the definite diagnosis is not reached by cytology alone and the need for tissue biopsy or even other ancillary methods becomes mandatory. This work aimed at studying the different cytomorphological features of pleural effusion samples in relation to other clinicopathological variables with special highlights on malignant cases in order to identify the role of cytology as an important diagnostic tool in cancer detection even before the clinical diagnosis. To perform this study, the slides of 606 cases of pleural effusion stained with H & E, Giemsa, and papanicolaou stains were collected from the archives of the Cytology Unit, Pathology Department, Faculty of Medicine, Cairo University, Kasr Al-Aini Hospitals, during the period from January 1, 2006 till December 31, 2010. The slides were revised and the results were statistically analysed. This study has found a statistical correlation between the clinical presentation and the cytological diagnosis. Also the relation between the gross appearance of effusion and the cytological diagnosis was statistically significant. In conclusion, these findings suggest that cytologic examination of pleural fluid is of great diagnostic value in both non-neoplastic and neoplastic effusions. Cytology also plays a central role in the etiological clarification of pleural effusion specially if good clinical data are available and sometimes it has an instructive significance in diagnosis of malignancy even before the clinical diagnosis.

Key Words: Cytology -- Pleural effusion -- Transudate -- Exudates -- Malignant effusions -- Mesothelioma.

Introduction

CYTOLOGY is the examination of individual cells regardless of the architectural structure of the tissue. Although cytology does not of always replace excisional biopsy and histopathologic examination, however, it's considered less invasive, more simple, inexpensive, allows faster diagnosis with low incidence of false positive diagnosis which may reach less than 1% and it facilitates cancer screening in some cases [1]. Examples of common sources of cytologic specimens include cutaneous and subcutaneous masses, body cavity fluids, lymph nodes, liver, spleen, pancreas, prostate gland, bone marrow, conjunctiva, respiratory tract, ear swabs, vaginal and rectal mucosa, and urine.

Regarding pleural effusion it can be broadly classified into two types; transudative and exudative [3]. The number and type of non neoplastic cells found in pleural effusions depend on a large extent on the pathogenic mechanisms of fluid formation, which determine whether an effusion is classified into exudate or transudate [4].

Transudative pleural effusion is caused by fluid leaking into the pleural space. Such leakage may be due to a variety of reasons but the most common one is the failure of the left ventricle. Patients suffering from complications after cardiac surgery have also often been diagnosed with transudative pleural effusion. Pulmonary embolism and cirrhosis are other common causes for this form of pleural effusion [8]. Exudative pleural effusion is caused by leaky blood vessels, which are in turn, caused mainly due to lung disease. Some of the most common causes of exudative pleural effusion are lung infections, tuberculosis, bacterial pneumonia, pulmonary embolism, breast cancer or lung cancer [6]. Drug induced lupus and some types of medications can also result in pleural effusion. Pleural effusion caused by medicines is not very acute, as the pleural fluid starts reducing in volume as soon...
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Arthritis may sometimes cause inflammation of the pleura [7]. Systemic lupus erythematosus and accidental infusion of fluids, are also among the other major causes of pleural effusion [8]. Rarer reasons are pancreatic, liver and kidney diseases, viral and fungal infections and mesothelioma [5].

Cytologic examination of pleural fluid is of great diagnostic value in both non-neoplastic and neoplastic effusions [9]. Also pleural effusions represent a significant percentage of samples received in the cytology lab [10]. Cytology also plays a central role in the etiological clarification of pleural effusion [11].

Effusions are often the first clinical symptom of malignant tumors or of their metastatic manifestation. In known malignancies effusions are an ominous sign [12]. Admittedly, finding cancer cells in such specimens denotes that the patient has cancer that is not only advanced but also almost always incurable [4]. Theryby cytologic examination may be the first, best or only chance for making the diagnosis of an underlying malignancy [10], in addition fluid cytology has also clinical significance in the management of patients with malignancy [12]. Accordingly the purposes of pleural fluid examination are to correctly identify cancer cells and if possible, to identify the tumor types and primary sites when presented with unknown primary tumor sites [10].

Apart from the finding of cancer cells, cytologic examination of pleural effusions may also reveal information about inflammatory conditions of the serous membranes, parasitic infestations, and infection with bacteria, fungi, or viruses. It can also supply evidence of the presence of a fistulous connection with a serous cavity [4].

Diagnostic difficulties in effusion cytology include distinguishing between reactive and malignant effusions with determination of malignancy type if present [13]. These difficulties may be aided by other ancillary methods such as special stains, immunohistochemistry, electron microscopy, flow cytometry and PCR [14].

The aim of this study was to revise the available archival slides of pleural effusion samples collected from the archives of the Cytology Unit, Pathology Department of Kasr Al-Aini Hospitals covering the period from January 2006 till December 2010 and to correlate between cytomorphological features detected in the slides examined and the clincopathological data present in the request sheet sent, with special highlights on malignant cases whether diagnosed clinically or not before sending the effusion sample.

Material and Methods

This is retrospective study. The material collected included 606 cases of pleural effusion smear slides. The slides were obtained from the archives of the Cytology Unit, Pathology Department, Faculty of Medicine, Cairo University, Kasr Al-Aini Hospitals, during the period from January 1st, 2006 till December 31st, 2010. Data required from the cytopathology sheet included: age, sex, clinical history, clinical diagnosis and the gross appearance of the fluid received.

The available archival slides were previously stained with hematoxylin and eosin, Papanicolaou technique (both after fixation with 95% ethanol) as well as giemsa stain after air drying. All available slides were cytomorphologically revised and some photos were captured with an Olympus digital camera (EX330) attached to an Olympus microscope model (BX51).

Cytomorphological evaluation:

Revision of all available slides was done and the following cytopathological features were evaluated:

- Cells present as regards their type, number, size, and whether they are present singly, in clusters or in sheets.
- Presence of rosettes, acini (groups with an empty center) & papillae (3 dimensional small groups).
- The cytoplasmic amount and the presence of cytoplasmic vacuoles.
- The nuclei as regards, shape, size, nuclear membrane, chromatin pattern and presence of nucleoli.
- Presence of malignant criteria such as nuclear and cytoplasmic moulding, marked nuclear & cellular pleomorphism, large prominent nucleoli, irregular nuclear contours, with hyperchromasia and abnormal chromatin clumping, granularity of chromatin and absence of nuclear membrane, high N/C ratio, nuclear haloes, atypical mitosis and multiple levels of cells in sheets or clusters.
- Background: either proteinaceous or dirty background (tumour diathesis) contained RBCs, inflammatory cells, debris and others as psammoma bodies.

Statistical analysis:

Analysis of data was done by SPSS (statistical program for social science version 15). Data were expressed as frequency & percentage or mean & range as appropriate. Chi-square test was used to
examine the relation between qualitative variables; comparison between two quantitative variables was done using student $t$-test.

All tests were 2 tailed, $p$-value less than 0.05 was considered significant & less than 0.001 was considered as highly significant.

**Results**

In the current study, 606 cases of pleural effusion were examined. The age of patients ranged patients between 2-95 years (mean 49 years). The highest percentage of cases (29%) was in the age group (50-60) years. Sex distribution among pleural effusion cases showed male predominance presenting (56.5%) of cases, while the females presented (43.5%) of cases.

**Table (1): Clinical conditions associated with pleural effusion cases (as reported in the request sheet referred from clinicians).**

<table>
<thead>
<tr>
<th>Clinical diagnosis</th>
<th>Number</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=606</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign conditions</td>
<td>486</td>
<td>80.2</td>
</tr>
<tr>
<td>Cardiac diseases</td>
<td>151</td>
<td>25</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>140</td>
<td>23.1</td>
</tr>
<tr>
<td>Liver Cirrhosis</td>
<td>144</td>
<td>23.7</td>
</tr>
<tr>
<td>CRF</td>
<td>34</td>
<td>5.6</td>
</tr>
<tr>
<td>Autoimmune diseases</td>
<td>14</td>
<td>2.3</td>
</tr>
<tr>
<td>Other conditions*</td>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>Malignant conditions</td>
<td>120</td>
<td>19.8</td>
</tr>
<tr>
<td>Lung and pleural tumors</td>
<td>55</td>
<td>45.81</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>33</td>
<td>27.5</td>
</tr>
<tr>
<td>Mediastinal tumors</td>
<td>10</td>
<td>8.33</td>
</tr>
<tr>
<td>Gastrointestinal tract (GIT) tumors</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>7</td>
<td>5.83</td>
</tr>
<tr>
<td>Others**</td>
<td>7</td>
<td>5.83</td>
</tr>
</tbody>
</table>

* Two cases of hydatid cyst disease and one case due to trauma to the chest. All were collected together for statistical purposes.

**Table (2): Types of malignant pleural effusion.**

<table>
<thead>
<tr>
<th>Types of malignant exudate (10.9%)</th>
<th>Number N=57</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesothelioma</td>
<td>16</td>
<td>28.0</td>
</tr>
<tr>
<td>Non-mesothelioma</td>
<td>41</td>
<td>72.0</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>100</td>
</tr>
</tbody>
</table>

In cytologically diagnosed malignant effusions associated with tumors other than mesothelioma, metastatic carcinoma of unknown primary was the most common cause presenting (34.2%) of cases (Table 3).

**Table (3): Types of malignancy (other than mesothelioma) in cytologically malignant pleural effusions.**

<table>
<thead>
<tr>
<th>Tumor type</th>
<th>Number N=41</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast carcinoma</td>
<td>12</td>
<td>29.3</td>
</tr>
<tr>
<td>Lung carcinoma</td>
<td>8</td>
<td>19.5</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>7</td>
<td>17.0</td>
</tr>
<tr>
<td>Unknown primary</td>
<td>14</td>
<td>34.2</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>100</td>
</tr>
</tbody>
</table>

Most cases of pleural effusion were clinically associated with benign conditions presenting (80.2%) of cases, among which cardiac diseases were found to be the most common cause presenting (25%) of cases.

The pleural effusion cases associated with clinically diagnosed malignant conditions presented (19.8%) of cases; among which lung tumors whether primary or secondary (33 cases) and pleural tumors (22 cases) were the most common presenting together (45.81%) of malignant conditions. Breast cancer was also a common presentation (33 cases) presenting (27.5%) of malignant cases.

Regarding the gross appearance of the fluid received, it was turbid yellowish in most cases (55.1%) and the rest of aspirates were hemorrhagic and clear yellowish in (29.8%) and (15.1%) respectively.

Upon cytological examination of the smears prepared (524/606 cases) (86.5%) were exudates and (82 cases) (13.5%) where transudates. In the exudative pleural effusions, the benign types were the most predominant presenting (467/524 cases) (89.1 %), most of them were reactive inflammatory smears (346/467) presenting (74.1%) of benign exudates. Regarding malignant exudates (57/524) cases were diagnosed (10.9%), 16 of them were mesothelioma and the rest (41 cases) were of tumors other than mesothelioma (Table 2).
patients clinically presented either with pleural effusion associated with a previously diagnosed malignancy (34/41) or, the cytological diagnosis of malignant effusion preceded the clinical diagnosis of malignancy in (7/41 cases), five of them were in patients having cardiac problems, one case of liver cirrhosis and one case was complaining of non specific respiratory problems.

In this study, the mean age of patients having benign exudate was 49 years while the mean age of patients having malignant exudate was 50 years. The relation between type of exudate and patient’s age was statistically insignificant (p value 0.6).

Malignant exudates were found more common in males (52.6%) than females (47.4%), while in benign exudates (57.2%) were males and (42.8%) were females. The correlation between type of exudate and patient’s sex was considered statistically insignificant (p value <0.4).

As regards the gross appearance, pleural fluid was hemorrhagic in (26.3%) of the benign exudates and (57.9%) of the malignant ones. The correlation between the gross appearance of the fluid and cytological diagnosis was considered highly significant (p value <0.001).

(486) cases were clinically diagnosed as benign conditions, (406/486) of them were associated with cytologically benign pleural exudates as well, while (7/486) cases were diagnosed cytologically as malignant exudates. The remaining (73) cases were diagnosed cytologically as transudates. The correlation between benign and the malignant pleural exudates as regards the clinical data and gross features are tabulated in Table (4).

Regarding the clinically diagnosed malignant cases (120), it was found that (61/120) of them were associated with benign pleural exudative effusion, while (50/120) cases were associated with malignant exudates mostly due to lung or pleural malignancy (56%) and nine cases were transudates (Table 5).

The correlation between clinical diagnosis and cytological diagnosis was considered highly significant (p-value <0.001).

<table>
<thead>
<tr>
<th>Clinical diagnosis</th>
<th>Benign exudate</th>
<th>Percent (%)</th>
<th>Malignant exudate</th>
<th>Percent (%)</th>
<th>Transudate</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Malignant:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung and pleural tumors (55)</td>
<td>23</td>
<td>37.8</td>
<td>28</td>
<td>56</td>
<td>4</td>
<td>44.5</td>
</tr>
<tr>
<td>Breast cancer (33)</td>
<td>19</td>
<td>31.1</td>
<td>12</td>
<td>24</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Mediastinal tumor (10)</td>
<td>8</td>
<td>13.1</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>GIT tumors (8)</td>
<td>6</td>
<td>9.8</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Lymphoma (7)</td>
<td>3</td>
<td>4.9</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Others (7)</td>
<td>2</td>
<td>3.3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td><strong>Total (120)</strong></td>
<td>61</td>
<td>100</td>
<td>50</td>
<td>100</td>
<td>9</td>
<td>100</td>
</tr>
</tbody>
</table>
Fig. (1): Smear of pleural fluid showing reactive mesothelial proliferation with moderately enlarged smoothly contoured nuclei, with some prominent nucleoli in a proteinaceous background (H & E x 200, original magnification).

Fig. (2): Smear of pleural fluid showing reactive mesothelial proliferation (Giemsa stain x 200, original magnification).

Fig. (3): Smear of pleural fluid showing atypical reactive mesothelial proliferation with moderately enlarged nuclei (Pap stain x 400, original magnification).

Fig. (4): Smear of pleural fluid showing mesothelioma with singly present malignant mesothelial cells (Papanicolaou stain x 400, original magnification).

Fig. (5): Smear of pleural fluid showing mesothelioma where the cells are forming a small ball-like cluster (mulberry appearance) (Papanicolaou x 1000 oil immersion, original magnification).

Fig. (6): Smear of pleural fluid showing mesothelioma where the cells are forming an irregularly outlined cluster with a clear space in between (window) (Papanicolaou x 200, original magnification).
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Fig. (7): Smear of pleural fluid with metastatic adenocarcinoma. The malignant epithelial cells are forming a ball-like cluster in a hemorrhagic background (Papanicolaou x 400, original magnification).

Discussion

Serous body cavities contact virtually all internal organs. Therefore, all types of processes that can affect these tissues (benign or malignant) can manifest changes in the serous fluid and always the effusion represents an underlying pathology [11].

Effusions are classified clinically as transudative or exudative. Exudates are sub-classified into: inflammatory or neoplastic [3]. Body cavity effusions are challenging because static fluids almost always accumulate neutrophils and macrophages. Protein content and cell number give some insight into exudate versus transudate [6]. The number and type of non-neoplastic cells commonly found in serous effusions depend on a large extent on the pathogenetic mechanisms of fluid formation, which determine whether an effusion is classified as a transudate or an exudate [4]. The distinction between transudate and exudate is made by protein concentration measurements performed in the clinical laboratory [6].

The pathophysiology of the formation of effusion involves the passage of fluid out of the capillaries in the serous membranes into connective tissues, then it pass through to reach the mesothelial layer. Disturbances of the mechanism that normally maintains this dynamic flow may result in accumulation of excess fluid [15].

Transudates result from an imbalance between hydrostatic and osmotic pressures while exudates result from injury to the mesothelium [6]. Non neoplastic pleural exudates are likely to be caused by pneumonia, pulmonary infarction, lung abscess, pleuritis or secondary bacterial infection of a transudate [4]. Malignant tumors may cause either exudative or transudative effusions. Exudates result as the neoplasm damages the capillaries of serous membranes. The pleura is a common site for many metastatic tumors and it’s also a primary site for mesothelioma. Transudates associated with malignancy may be due to failure of fluid resorption caused by mechanical interference by the neoplasm [6].

In this retrospective study 606 cases of pleural effusion were revised and statistically analysed. The age range of patients was from 2 to 95 years (mean 49 years) with the highest percentage of cases (29%) in the age group (50-60) years. These results were in concordance with what was reported by Kushwaha et al., [16] who examined 100 pleural fluid samples and they found that the ages of the patients ranged from four to 75 years, with maximum percentage of cases (29.36%) was in the sixth decade. Also, Dagli and his colleagues [17] have examined 298 pleural fluid cases, the age range of which was between 15 and 89 with a mean value of 58.4.

Sex distribution among pleural effusion cases showed slight male predominance (56.5%), this was in concordance with what was reported by Kushwaha et al., [16] who noted also male predominance with the ratio of male to female being 1.2:1. However, these results were in contrast to those obtained by Dagli et al., [17] who found that out of the total 298 pleural fluid samples collected, (38.3%) were females and (61.7%) were males, this difference may be due to different referral centers.

The clinical diagnosis of pleural effusion cases showed that (80.2%) of cases were clinically diagnosed as benign conditions, while the malignant...
ones presented (19.8%). These results were in agreement to what was reported by Hackbarth et al., [18] that non-malignant conditions such as pneumonia, heart failure and liver disease were found in 80% of cases while malignancy-related conditions made up the remaining 20%.

Cardiac disease was a common cause of the clinically diagnosed benign conditions associated with pleural effusion presenting (25%) of cases. This finding agreed with what was noted by Mare, [19] that cardiac diseases presented the most common cause (45.8%) of pleural effusions in his study. But, these results didn't go with what was reported by Valdes et al., [20] and Kushwaha et al., (2008) [16] who found that tuberculosis was the most frequent cause of pleural effusion presenting (25%) and (39.02%) of cases respectively.

The difference in results between the current study and other studies as regards the etiology of pleural effusion is mainly attributed to the difference in patient's age, sex, residence and the methods of diagnosis of the underlying conditions. Also the clinical presentation that is observed and reported in any study may also depend on the type of subject covered by that study [21].

In the present study (86.5%) the pleural effusion cases were exudates & (13.5%) were transudates, these percentages were slightly lower than what was reported by Kushwaha et al., [16] that 82% of samples were exudative and 18% were transudative. Among the pleural exudates examined (89.1%) were benign most of them were reactive inflammatory smears (74.1%).

Malignant pleural exudates presented (10.9%) of all pleural exudates; (28%) of them were diagnosed as mesothelioma while (72.0%) where due to tumors other than mesothelioma among which metastatic breast carcinoma, lung cancers, lymphoma and metastatic carcinoma of unknown primary presented (29.3%), (19.5%), (17.0%) and (34.2%) of cases respectively.

The percentage of effusions due to breast carcinoma in this study (29.3%) was close to what was reported by Ong et al., [22] who found that among 103 patients examined, breast carcinoma was detected in (29.1%) of cases.

This study has detected that lung carcinoma was diagnosed in (19.5%) which was lower than what was reported by the Ong et al., [22] who found that the percentage of the lung carcinoma was (51.5%). Also, in the current study the percentage of malignant mesothelioma, lymphoma and metastatic carcinoma of unknown primary was higher than what was reported by the same authors that in their study the percentage of malignant mesothelioma and lymphoma was (1% each) while metastatic carcinoma of unknown primary presented (9.7%) of cases.

The results of cytological diagnosis of malignant pleural effusion cases were also close to what was reported by Johnston, [23] who found that among 584 malignant pleural fluid samples examined, (75.5%) of cases were caused by clinically diagnosed carcinoma with known primary and (13.8%) cases were caused by lymphoma. On the other hand, in the same study (10.1%) cases were due to metastatic carcinoma of unknown primary and only three cases (0.5%) were diagnosed as mesothelioma. These latter findings were completely different from the current study in which among the 57 malignant exudates diagnosed (28.0%) of cases were diagnosed as mesothelioma and (24.5%) were diagnosed as metastatic carcinoma of unknown primary.

The results in this work did not coincide with the study performed by Valdes et al., [20] who observed malignant cells in (22.9%) of 642 pleural effusions including cancer of lung (32.6%), breast (11.5%), ovary (7.5%), and (14.3%) metastatic carcinomas of unknown primary (10.8%) of cases were due to lymphoma.

Also, results in the current study was different from what was detected by Sahn, [24] who found that carcinoma of lung, breast, lymphoma and unknown primary constituted (36%), (25%), (10%) and (7%) respectively.

Finally percentage of different cancers in the present study was higher than what was reported by Kushwaha et al., [16] who noted that breast cancer and lymphoma comprised (7.14%) each while lung carcinoma made up (3.57%) of cases in their study. All these differences between the results of the present study and the other studies are probably due to difference in the sample size, patient's age, sex and different referral units.

Regarding mesothelioma, it represented (28.0%) of malignant exudates in the present study, this percentage was higher than what was reported by Gaur et al., [25] and Kushwaha et al., [16] who diagnosed mesothelioma in (15.7%), (21.4%) respectively. Both studies were performed in India.
Another two studies were performed in Turkey by Cakir et al. [26] and Dagli et al. [17] and mesothelioma was detected in (8.8%) and (22.6%) respectively.

The difference in mesothelioma incidence among different studies could be explained by the different geographic regions and variable sample size. This high percentage in the current study confirms what was reported by Gaafar and Eldin [27] that the incidence of mesothelioma is raising in Egypt.

Upon comparing between the cytological diagnosis of pleural fluid and other clinico pathological variables, it was found that the mean age of patients with benign effusion was 49 years and in patients with malignant effusion it was 50 years. Antonangelo and his colleagues [28] reported that the mean age of patients with malignant effusions was (52.6%) while (47.4%) were females. These results were not coinciding with the study done by Kushwaha et al., [16] who found that malignant pleural effusion was more prevalent in females with a (female/male) ratio (2.1:1). This difference may be due different sample size and referral units. Also the results were different from what was reported by Antonangelo and his colleagues [28] who found female predominance among malignant pleural effusion cases presenting (66%) as they performed their study in an out patient clinic where many breast cancer patients were examined.

Finally these results weren’t in harmony with what was mentioned by Rubins and Mosenifar [29] that about two thirds of malignant pleural effusion cases occur in women due to breast or gynecologic malignancies.

Regarding the clinically diagnosed malignant cases, it was found that (61/120) of them were associated with benign (120) pleural exudative effusion, while (50/120) cases were associated with malignant exudates mostly due to lung or pleural malignancy (56%) and nine cases were transudates. On the other hand among the clinically diagnosed (486) benign conditions, (406) cases were cytologically benign and in seven cases malignancy was diagnosed cytologically before the clinical diagnosis. This means that pleural effusions associated with clinically diagnosed malignant conditions are not always malignant. In addition, these findings have revealed that the cytological diagnosis of malignancy may precede the clinical diagnosis in some cases.

The correlation between clinical diagnosis and cytological diagnosis was considered highly significant (p-value <0.001).

Regarding the gross appearance of the fluid received, it was found to be hemorrhagic in (26.3%) of benign exudates and (57.9%) of the malignant ones. The correlation between the gross appearance of the fluid received and the cytological diagnosis was considered highly significant (p-value <0.001). This means that hemorrhagic effusions should arouse the suspicion of malignancy. These results are close to those of Kushwaha and his colleagues [16] who found (71.43%) of malignant effusions were hemorrhagic.

In conclusion, the present study demonstrates that the most useful test in establishing the diagnosis of pleural effusion is pleural fluid cytology. Cytologic study of pleural fluid is a complete diagnostic modality which aims at pointing out the etiology of effusion even before the clinical diagnosis in some cases. It also has an important value in prediction of disease progression in malignant conditions. The study of cytomorphic features of various metastatic malignant cells in pleural effusions may provide definite clues regarding the primary site. Thus, patients with an undiagnosed pleural effusion should be thoroughly evaluated. The correlation between clinical examination and cytologic study is considered an essential step in diagnosis of disease and its progression.

References


