INTRODUCTION

Accumulation of body fluids (effusions) is an abnormal clinical finding. Effusions can occur in multiple sites within the body including the pleural, peritoneal, and pericardial cavities. Patients may require medical or surgical treatment to alleviate symptoms from the presence of an effusion. Fluid can be collected from the body site and submitted to the laboratory for testing. The results of the fluid analysis provide useful information in determining the etiology of the effusion, diagnosing a significant disease or medical condition, and in providing appropriate clinical treatment.

Fluid accumulation can be associated with a broad group of medical etiologies comprising infections, malignancies, non-malignant conditions, and trauma. A fluid sample is obtained and sent for laboratory testing that often includes cell count and differential, chemical analysis, and microbial evaluation. The composition of a fluid can be evaluated for various analytes such as protein, glucose, and pH. Microscopic examination and cell identification of a fluid sample provides additional information pertinent to a patient’s medical state.

A comprehensive review of all laboratory and clinical features of body fluids is beyond the scope of this education activity. This learning activity focuses on selected laboratory and clinical aspects, with an emphasis on fluids from pleural, peritoneal, and pericardial cavities. The anatomic, physiological, and pathological features that contribute to the development of an effusion within these cavities are discussed.

Various types of cells, including hematological and non-hematological cells, can be seen on microscopic examination of a fluid sample. Although identification of many cells is relatively straightforward, cell classification can be nevertheless challenging in some instances. For a given cell type, diverse morphological features can exist. Macrophages, mesothelial cells, and malignant cells are examples of cells that can vary in size and appearance. These three cell types have heterogeneous morphological appearances that can be problematic in accurately identifying individual cells. In cases where cell identification may be indeterminate solely on morphology evaluation, ancillary techniques may be used as aids in determining cell type. Immunocytochemistry, flow cytometry, and molecular testing using DNA and RNA sequencing are specialized techniques that can be further used in determining an appropriate cell classification.

The participants are encouraged to review the cited references, provided at the end of this education activity, for further information on body fluids. Images from the Color Atlas of Body Fluids are used as illustrations within the text of this education activity and in the online learning assessment section. The atlas should be used as a supplement in reviewing this current learning material.
ANATOMIC SITES OF FLUID ACCUMULATION

A basic understanding of pertinent anatomy and physiology is needed in order to understand how fluid can accumulate in pleural, peritoneal, or pericardial cavities. The lungs are lined by pleura; the heart is lined by pericardium; and the abdominal cavity lined by peritoneum. The lining of each anatomic region is virtually identical and consists of two layers of membrane, (i.e., the visceral and parietal membranes). Both membranes are quite thin.

The parietal membrane is the outer lining and the visceral membrane is the innermost lining, (i.e., directly surrounding the organs). Mesothelial cells comprise both membranes. A small amount of fluid (few milliliters) is present between the parietal and visceral membranes. This small amount of fluid serves essentially as a lubricant between the parietal and visceral membranes to prevent friction and to facilitate movement of underlying organs. The pleural, peritoneal, and pericardial membranes enclose their respective organs as closed cavities. Blood capillaries and lymphatics surround the membranes.

How do Increased Volumes of Fluid Accumulate in Pleural, Peritoneal, or Pericardial Cavities?

- In a basic overview, blood flows to the parietal membrane of a cavity. Within the blood are proteins and other molecules essential to life.
- Blood flows through the parietal membrane where it is filtered. Blood subsequently flows into the visceral membrane where proteins and other essential molecules are reabsorbed for further use within the body.
- This ongoing process of flow and reabsorption is dependent on pressures (hydrostatic and oncotic, respectively) and on the integrity of the parietal and visceral membranes to maintain physiological equilibrium.
- If there are significant pressure changes or damage to the membranes, fluid can accumulate in a closed cavity.
- Normally, the rate of filtration and reabsorption is similar as reflected in comparable hydrostatic and oncotic pressures.

In essence, three factors contribute to fluid accumulation or effusion within pleural, pericardial, or peritoneal cavities. These include:

1. Increased blood flow (hydrostatic pressure)
2. Decreased reabsorption (oncotic pressure)
3. Damage to the parietal and visceral membranes

Effusions occur in a variety of diseases, medical conditions, and traumatic events. Fluid accumulation within the pleural, peritoneal, or pericardial cavities can impair organ function. An example is trauma to the pericardial sac. If a weapon such as a knife penetrates the pericardium, a large amount of blood can accumulate within the pericardial cavity. This excessive fluid can impede the heart’s capability to expand and contract. Consequently, cardiac pumping action, (i.e., blood flowing to and exiting from the heart) can be impaired. If severe, death will ensue.
There are diseases that can affect the integrity of the parietal and visceral membranes. An example is rheumatoid arthritis, which is a systemic inflammatory disorder. Rheumatoid arthritis can affect multiple organs and body sites, including the pleural and pericardial membranes.

In some malignancies, tumor obstructs vascular and lymphatic flow. This can occur if a tumor is bulky, and its large size can encase blood vessels and subsequently impede blood flow. Another example is tumor involving the lymphatic channels. When malignant cells metastasize to lymph nodes, the tumor cells can impair the lymphatic channels. In these examples of impaired lymphatic and blood flow, hydrostatic and oncotic pressures can be significantly altered. As a result, fluid can accumulate. The clinical aspects of effusions will be further discussed in this education activity.

**SPECIMEN PROCUREMENT AND PROCESSING OF FLUIDS**

Some effusions in a cavity, particularly if the fluid quantity is small, can resolve without fluid removal or further treatment. However, if there is a significant fluid accumulation, the increased fluid can cause the onset of distressing symptoms in a patient. Fluid accumulation has the potential for organ damage within a cavity. In these circumstances, further intervention to remove the fluid becomes necessary.

Removal of fluid within the pleural, peritoneal, or pericardial cavities is performed using sterile techniques. In essence, a wide-bore needle/catheter is placed through the body wall into the fluid-filled cavity. Appropriate placement of the needle can be accomplished through the use of radiological studies. Through these specialized studies, internal visualization occurs and therefore the needle can be guided to the fluid-filled cavity without damaging adjacent organs. After the needle is appropriately placed, fluid can be obtained. It is vital that fluid specimens be evaluated for laboratory testing as soon as possible. When there are delays in specimen processing, degenerative changes of cells occur. Fluid can be collected as multiple specimens, which can be subsequently evaluated for a variety of tests that include chemistry, hematology, microbial, and cytology analyses.

The removal of pleural fluid is called thoracentesis. Pleural fluid can be obtained through entry into the chest or back. Skin at the site of intended entry is prepped/sterilized, and a local anesthetic is injected. After the needle is appropriately positioned within the pleural cavity, a catheter is placed within the needle so that the fluid can be obtained.

Removal of peritoneal fluid is known as paracentesis. Using sterile technique, a relatively large bore needle/catheter is inserted approximately 4-5 cm below the umbilicus. Fluid removed from the peritoneum is called ascitic fluid.

Removal of pericardial fluid is pericardiocentesis. In this procedure, a patient is usually sitting and leaning slightly forward so that the fluid can be collected in the anterior and inferior portions of the pericardial sac.
The needle is inserted between the lower portion of the sternum (xyphoid process) and left rib cage margin or at the left sternal border in the region of the fifth or sixth intercostal spaces. During the procedure, an echocardiography (EKG) machine monitors the patient’s heart. The monitoring is done to ensure correct placement of the needle/catheter and to prevent any needle damage to the heart. For patients with recurrent pericardial effusions that necessitate ongoing drainage, surgical intervention may be necessary. In these instances, a section of the pericardial tissue is surgically removed so that a chest tube can be placed for fluid removal.

The fluid collected is tested in the laboratory. The physical appearance of the fluid including color, clarity, and viscosity can provide valuable clues in ascertaining the etiology of the effusion. Most fluids are clear or pale yellow, findings that are usually associated with non-inflammatory medical conditions. Turbidity of the fluid specimen is often associated with increased cellularity. Turbid cavity fluid may be due to increased white blood cells, as seen in an infectious process or to the presence of malignant cells.

Several different laboratory tests can be performed on fluid samples from pleural, peritoneal, and pericardial cavities. Various chemical tests include measurements for pH, protein, glucose, enzyme, lactate, and cholesterol. In cases of suspected infections, Gram stain and cultures may be obtained. Molecular, tumor marker, and immunological tests can also be performed on fluid samples as clinically indicated.

For microscopic identification and enumeration of cells, a cell concentration method such as cytocentrifugation is used to prepare fluid specimens. After sample processing and staining (Wright-Giemsa) are completed, a differential count is performed. Specimens are evaluated for the presence of various cell types including neutrophils, eosinophils, basophils, lymphocytes, macrophages, mesothelial cells, and malignant cells. A fluid sample can also be processed for cytological evaluation utilizing cytopsin and cellblock techniques. Cytological examination is an important tool especially in diagnosing malignancies. Immunohistochemical stains to determine the cell origin or lineage of a malignancy can be performed on cellblock materials.

**TRANSUDATES AND EXUDATES**

Following completion of laboratory testing, the findings can be used to classify fluid from the pleura, peritoneum, or pericardium as hemorrhagic, transudate, or exudate. Hemorrhagic fluids are often the result of trauma or rupture of a large blood vessel as seen in an aortic aneurysm. The aorta is the major blood vessel of the body. If rupture occurs, massive internal hemorrhage develops and copious bloody fluid accumulates within the peritoneal cavity. Surgical repair of the aorta is needed as a life saving treatment.

There are criteria for determining if an effusion is a transudate or an exudate. This distinction is made clinically following review of laboratory results of the fluid analysis. By making this distinction, clinicians can determine possible medical causes of an effusion. If the etiology of an effusion can be determined, appropriate medical treatment can be given.
In most patient populations, non-inflammatory transudates are more common than inflammatory exudates. Transudates have lower protein and specific gravity values than those of an exudate. The cell composition of a fluid, including number and type of cells, is a factor in determining if the effusion is a transudate or exudate. In general, the number of cells is lower in a transudate than in an exudate. Increased inflammatory cells and the presence of malignant cells are seen in exudates.

Transudates form when the fluid outflow (increased hydrostatic pressure) exceeds the normal resorption across a membrane (decreased oncotic pressure). Transudates have low protein counts (less than 3.0 grams per deciliter [g/dL]) and a specific gravity that is less than 1.015. Leukocyte counts are usually less than 1000 cells per microliter for pleural effusions and less than 300 cells per microliter for peritoneal fluids. In transudates, mononuclear cells are seen. Transudates are associated with a variety of clinical conditions including congestive heart failure, liver failure secondary to cirrhosis, and renal failure.

Exudates occur when there is damage to blood vessels and the subsequent escape of proteins and cells from the blood across capillary walls and into the surrounding tissues. Consequently, an exudate has a higher protein and specific gravity counts than those of a transudate. In an exudate, protein content is greater than 3.0 g/dL and the specific gravity greater than 1.015.

In congestive heart failure, pleural and/or pericardial effusions can develop. These effusions are usually transudates in nature. However, concomitant medical conditions such as infection and acute inflammation can be present with increased infiltrates of neutrophils. The increased neutrophils affect the fluid effusion composition. In such instances, the fluid effusions would best be classified as exudates.

There are additional tests that can aid in determining if a fluid is a transudate or exudate. Chemical tests can be performed on a fluid sample for cholesterol or albumin levels. The quantitative levels are determined, and comparing the serum to fluid ratios for cholesterol or albumin can be used to classify an effusion as a transudate or exudate.

From a clinical perspective, when a fluid is considered to be a transudate, additional laboratory testing of the fluid is generally not necessary. For an exudate, additional evaluation of the fluids may be necessary depending on the patient’s medical condition. Tests for tumor markers or infectious agents may be performed on fluid samples if clinically necessary.

**CELLS: IDENTIFICATION AND FUNCTIONAL ASPECTS**

An essential aspect in the laboratory evaluation of an effusion is identification of cells that are present in the fluid sample. However, there are challenges in assessing body fluids, especially in the microscopic cell examination. An effusion can be clinically of an acute onset as seen in some bacterial infections or can be recurring or chronic as seen in patients with long standing lung and cardiac diseases. Depending on the...
patient’s underlying medical conditions, an effusion may be bloody and turbid. All these factors can impact the morphological appearance of a cell. Degenerative cellular changes may occur. Variations in staining properties of cells may be noted. Alterations in cell morphology may be problematic in correctly identifying and classifying cells upon microscopic review.

Macrophages, mesothelial cells, and malignant cells can be present in fluids from the pleural, peritoneal, and pericardial cavities. Each of these cell types can have heterogeneous morphological features. For macrophages and mesothelial cells, heterogeneity in appearance can be due to the functional activity or response of a cell to its physiological or pathological environment. For example, mesothelial cells can become significantly larger when undergoing reactive changes. Malignant cells differ in appearance both for a given tumor type and among tumors of different origins. A function of macrophages is “cleaning up” or phagocytosis, and these cells undergo significant changes in cell size depending on functional activity. When performing a microscopic examination of cells, it is useful to relate the morphological structure and functional purpose of a given cell.

In general, cells have life cycles. Depending on the specific type of cell, phases may include proliferation with mitotic activity, maturation, regeneration, degeneration, and apoptosis or cell death. There may be morphological changes for a given cell depending on its life cycle/phase.

A typical cell nucleus consists of chromatin, which is DNA and proteins. Within the nucleus, RNA synthesis occurs. Nucleoli are small spherical shaped bodies located within nuclei. Nucleoli contain ribosomal RNA genes used to synthesize proteins. A nucleolus may be seen in malignant cells, although it can also be seen commonly in non-malignant cells, especially in those cells producing increased protein during repair or reparative processes. Cytokines are secreted proteins from cells. There are various cytokines with differing functions. Cytokines are present in inflammatory conditions and help to maintain the body’s immune system.

Macrophages

Macrophages are derived from monocytes, which circulate in the blood. Both cells are vital to the body’s immune system. When monocytes enter tissues and body fluids, they can undergo morphological transformation and become phagocytic. These cells are called macrophages. The word macrophage is derived from the Greek words phagos and kytos, which mean eating cells. Macrophages provide an immune response by destroying ‘foreign’ antigens. These cells can ingest microorganisms, foreign material, cells, and cellular debris. Macrophages produce several products that include cytokines, enzymes, and coagulation plasminogen activator. Organisms may be present within macrophages and may be destroyed through lysosomal enzymes. While macrophages have properties that are beneficial to the body, their products including cytokines can result in injury to tissue. Macrophages move by amoeboid action as reflected cytoplasmic protrusions. Typical macrophages and their characteristics can be found in Table 1.
Table 1. Typical Macrophages and Key Facts

<table>
<thead>
<tr>
<th>Macrophage</th>
<th>Facts</th>
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| Benign macrophage | - Macrophages are characterized by round or bean shaped nuclei and lacy cytoplasm that often contains vacuoles and or ingested debris.  
- Macrophages may have one or more nuclei. Nucleoli can be seen that may be central or eccentric placed within the nuclei.  
- Cytoplasm is rather abundant.  
- The average size of a macrophage is 20 – 40 microns, although the cells can increase in size. Variation in size is considerable and can range from approximately 15 to 100 microns. Of note, a typical red blood cell measures 7 microns.  
- Since a macrophage has phagocytic functions, its cytoplasm frequently contains vacuoles. Phagocytosed cells or cell remnants may be noted in the cytoplasm of macrophages.  
- Erythrophages are macrophages, containing phagocytosed red blood cells. Macrophages containing ingested red blood cells can be an indication of prior hemorrhage. When macrophages ingest red blood cells, the iron in the ingested erythrocyte can be salvaged for re-use in the body.  
- Siderophages are macrophages containing hemosiderin, which is remnant material from ingested red blood cells.  
- Lipophages are macrophages with large vacuoles containing lipids with lipid pneumonia or can have small uniform vacuoles that can be from ingesting fatty materials or from the membranes of ingested cells. Since cells frequently degenerate in body fluids, it is not uncommon to see macrophages containing phagocytosed debris from cell breakdown.  
- Macrophages can contain crystals. |

The arrowed cells are vacuolated macrophages in loose clusters.
Table 1. Typical Macrophages and Key Facts, cont’d

<table>
<thead>
<tr>
<th>Macrophage</th>
<th>Facts</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>- Neutrophages are macrophages, containing phagocytosed neutrophils.</td>
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</table>

The arrowed object is a macrophage with a degenerating neutrophil in the cytoplasm.

<table>
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<th>Macrophage</th>
<th>Facts</th>
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<tbody>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>- Macrophages can contain phagocytosed organisms including fungi and bacteria.</td>
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</table>

The arrowed cell is a degenerating neutrophil with large phagocytic vacuoles and numerous deeply basophilic bacilli.
Mesothelial Cells

Since mesothelial cells line the pleural, peritoneal, and pericardial spaces, these cells can shed and are frequently found in fluids. Mesothelial cells may be seen single, in pairs, in groups of 3 or more cells, or in large sheets comprised of 10 or more cells (Table 2. below).

Table 2. Mesothelial Cells and Key Facts

<table>
<thead>
<tr>
<th>Mesothelial Cells</th>
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<tbody>
<tr>
<td></td>
<td>• Typical mesothelial cells have single round to oval nuclei with an evenly distributed chromatin pattern. A nucleus can be present.</td>
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<td></td>
<td>• Most mesothelial cells measure approximately 25 microns although there can be considerable variation in size due to nuclear and cytoplasmic changes.</td>
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<tr>
<td></td>
<td>• Mesothelial cells have a dense basophilic cytoplasm that can vary in color due to stain intensity. The perinuclear region may appear lighter.</td>
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<td></td>
<td>• The cytoplasm of mesothelial cells may appear foamy. It is believed that mesothelial cells may have phagocytic capability.</td>
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<td></td>
<td>• The cell outline of mesothelial cells can have a scalloped appearance. Mesothelial cells have microvilli. When viewed microscopically, the rim of the cytoplasm can have a fine beaded appearance or contain small vacuoles.</td>
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<tr>
<td></td>
<td>• Mesothelial cells often appear uniform. Multiple mesothelial cells can be present as pairs, clusters, or in sheet formation. The presence of thin spaces or clefts between cells may be noted. These clefts or so-called windows between apposing cell membranes are a useful clue in accurately identifying mesothelial cells.</td>
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<tr>
<td></td>
<td>• In chronic effusions, mesothelial cells can proliferate and binucleated and multinucleated cells can form.</td>
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Malignant Cells
The morphological characteristics of malignant cells vary, and the diversity of features reflect site of tumor origin and cell lineage. For this education activity, basic highlights of non-hematopoietic malignant cells are discussed. When examining a fluid slide particularly under low power, examination for cell clumping or aggregates should be made. This may indicate the presence of malignant cells, although cell features need to be evaluated on higher magnification. Malignant cells and their characteristics can be found in Table 3. below.

Table 3. Malignant Cells and Key Facts

<table>
<thead>
<tr>
<th>Malignant Cells</th>
<th>Facts</th>
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</table>
| ![A loose cluster of malignant cells is arrowed.](image) | - Malignant cells vary markedly in size depending on tumor type. The presence of a distinct cell population with unusual and pleomorphic features should prompt consideration for malignancy.  
- Malignant cells often have high nuclear to cytoplasmic ratios.  
- Malignant cells often have nuclei with irregular nuclear membranes.  
- Malignant cells often have nuclei with a variable chromatin pattern that appears morphologically to be uneven or coarsely clumped.  
- Malignant cells can have variability in shape.  
- Malignant cells can be single or appear in clusters.  
- Malignant cells can be multinucleated, have intracytoplasmic vacuolization, and demonstrate phagocytic activity. This latter feature is known as cannibalism in which one malignant cell ingests another. |

Miscellaneous Cellular Features
The presence of vacuoles in cells from pleural, peritoneal, and pericardial fluids is not uncommon. The presence of cytoplasmic vacuoles can signify phagocytic activity within a cell; and in macrophages, vacuoles are a normal and expected cytoplasmic finding. However, some malignant cells can have in their cytoplasm clear spaces that resemble macrophage vacuoles. These vacuoles can be seen especially in cancers arising from the stomach or breast. The clear spaces often contain mucin. The presence of vacuoles can also be an artefactual phenomenon secondary to specimen processing, most notably cytocentrifugation. Vacuoles can be seen in cell nuclei and/or cytoplasm.
These examples of vacuole findings underscore the potential pitfalls in accurately identifying cells. Caution needs to be exercised especially if one criterion is used to make definitive cell identification. It is important to carefully examine cells including the detection of subtle morphological characteristics that may aid in rendering the appropriate identification.

Cells undergoing mitoses can be seen in body fluids (Image 1. below). Mitotic figures denote actively dividing cells. Mesothelial cells can divide, and mitotic activity of mesothelial cells can be seen in reactive and chronic effusions. The presence of mitoses, however, should prompt a careful microscopic review of the fluid for the presence of malignant cells.

Cells, undergoing degenerative changes, are not uncommon in effusions. As a cell dies, nuclear and cytoplasmic changes occur. In the nucleus, the chromatin condenses (pyknosis) with subsequent nuclear fragmentation (karyorrhexis). The cytoplasm may have vacuoles and the cytoplasm may become indistinct (Image 2. below).

**DISEASES AND MEDICAL CONDITIONS**

The abnormal collection of fluid in body cavities can be due to various causes, including infection and malignancy. Some effusions may be small or, if viral in etiology, may undergo resolution without treatment intervention. However, abnormal fluid accumulation can result in adverse patient symptoms and compromise organ function. The following diseases and clinical conditions are associated with effusions, some of which can occur in multiple anatomic locations.

Malignant tumors can obstruct normal lymphatic and vascular flow and consequently, fluid can build up and accumulate in pleural, peritoneal, or pericardial cavities and within organs. In some cases, identification of tumor cells in a fluid sample may be the first clinical indication of the presence of a malignancy.
Rheumatoid arthritis is an inflammatory disorder with a putative autoimmune origin. Although rheumatoid arthritis mainly affects synovial tissue and joints, it is not a disorder that is limited solely to joints and the musculoskeletal system. Rheumatoid arthritis shows inflammatory changes affecting the lining epithelium of the pleural and pericardial cavities. Pleural and pericardial effusions can occur. Macrophages can be seen in the examination of fluid samples; and if significant inflammation is present, neutrophils may also be seen.

**Pleural**

As previously mentioned, cardiac failure is a major cause of a pleural effusion. When malignant cells are noted in pleural effusions, a tumor originating in the lung or breast should be considered as a possible cause. Malignant mesothelioma affects the pleura, and effusions are not unusual. Prior exposure to asbestos is linked to the development of this malignancy. As pleural fluid accumulates, patients develop increasing difficulty in breathing. Of note, mesotheliomas can also occur in the peritoneum.

**Peritoneal**

For peritoneal effusions, most are transudates with liver disease especially cirrhosis as a major cause. Destruction of liver cells can impair venous outflow with subsequent fluid accumulation in the peritoneal cavity. When relatively large amounts of fluid form in the peritoneal cavity, a patient can present with abdominal distention or girth.

Malignancies from the ovary and colon can cause peritoneal effusions. Abdominal swelling may be the first manifestation of the malignancy. A tumor can be bulky, and its large size can impair lymph flow.

**Pericardial**

In cardiac tamponade, the rapid accumulation of fluid in the pericardial sac can cause chest discomfort in the patient. Build-up of fluid around the heart causes dysfunction in the heart’s pumping capabilities. Blood flow is impaired and a significant decrease in blood pressure occurs. Immediate cardiac treatment is needed.

Viral infections, particularly Coxsackie viruses can be associated with pericardial effusions. Lymphoma is a malignancy that has been associated with the presence of pericardial effusions.

**SUMMARY**

Accumulation of fluid (effusion) within pleural, peritoneal, or pericardial cavity sites has various etiologies. In some cases, fluid development may occur rapidly, thus necessitating immediate life-saving treatment. In other cases, effusions develop over a longer period of time. In some instances, a patient may present with symptoms associated with an effusion. Removal of fluid from a cavity site may be performed for diagnosis or treatment or a combination of both. From a clinical perspective, determining the cause of an effusion and initiating appropriate treatment can be a challenge.
Likewise, from a laboratorian perspective, analysis of body fluids has multiple aspects and challenges. Cells in body fluids appear three-dimensional and identification of cells may not always be straightforward. For a given cell type, there can be various morphological features. Also, overlapping morphological characteristics among different types of cells can influence cell identification. Other factors such as cell degeneration or regeneration or staining variations can affect morphological features. A purpose of this education activity is an awareness of the problems and pitfalls in cell identification. Macrophages, mesothelial cells, and malignant cells were selected since these cells have a wide range of morphological characteristics. Complete resolution of these issues cannot be accomplished in this limited education activity. The participants are encouraged to review the references for further details and information.

This education activity has provided information on the pathophysiology of effusion development. The clinical significance of diseases and medical conditions associated with effusions has been mentioned. The laboratory evaluates effusion samples and provides essential information on the nature of an effusion. The laboratory findings are vital to a patient’s diagnosis and treatment plan.
References


Additional Resource

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Education Activity Contributor

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