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Thoracic and Abdominal Fluid Evaluation: Immediate essential information on critical and non-critical patients

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Thoracic and abdominal fluid accumulation in animals can be associated with a chronic gradual or acute critical presentation. Characterization of the fluid becomes an essential component of the patient work-up to both help identify the mechanism of formation of the fluid and to guide therapeutic intervention. There are several commonly used categories for fluid characterization including transudate, modified transudate and exudate and there are general guidelines for these characterizations and the differential for the mechanism of these fluid formations are somewhat different and therefore provide some direction in limiting the clinical differential but there is significant overlapping of characteristics and similar mechanisms can result in different types of fluid formation, so this categorization has limited value. The categorization is primarily related to gross, chemical (primarily total protein content) and quantitative cytologic features; however, the microscopic characterization of the fluid regarding the types of cells present are an essential component to help identify the underlying cause of the fluid formation itself. Even if no protein content or quantitative cytologic assessment is performed, the microscopic evaluation of the types of cells present is something that can provide immediate information about the fluid and is the most important component of the fluid assessment. The different categories of fluid formation including what is considered normal for the dog and cat are characterized below.

Normal Findings: Pleural and peritoneal fluid collection is difficult in the normal dog and cat because of the limited volume present and the trapping of this fluid between thoracic and abdominal viscera. Protein content is typically much less than 30 g/L and the total cell count is generally less than 500x10⁶/L. Cells present in normal pleural, pericardial, and peritoneal fluids include low numbers of mesothelial cells and occasionally seen inflammatory cells. Mesothelial cells are present in small clusters or as individuals. If knocked loose from the cavity lining during the collection process, mesothelial cells resemble squamous cells with a low N/C ratio and abundant faintly basophilic cytoplasm. Mesothelial cells that have naturally exfoliated into the fluid are rounded up and are quite basophilic (“dark” mesothelial cells). They measure between 25 and 35 µ in diameter. Nuclei are centrally located, round, and uniformly granular. Cytoplasm is abundant. The most striking characteristic of these cells is the presence of an eosinophilic peripheral brush border or “skirt” if they have exfoliated recently.

The inflammatory cells present in normal fluids have the morphology of normal peripheral blood leukocytes. The predominant leukocyte seen varies with the species. In dogs and horses, neutrophils are prevalent. In cats and cattle, lymphocytes predominate.

Transudate: Transudates are defined as excessive accumulations of fluid having normal characteristics. Transudates therefore have low total protein (less than 30 g/L) and low nucleated cell counts (less than 500 nucleated cells x10⁶/L) for the dog and cat. These fluids are commonly the result of venous stasis and less frequently from hypoalbuminemia and lymphatic obstruction (congestive heart failure, liver failure, the nephrotic syndrome, and in some cases of neoplasia. It is emphasized that pleural and peritoneal effusions due solely to hypoalbuminemia will only occur when serum albumin levels fall below 10 g/L.

Transudative fluids are quite clear at the time of collection. While most transudates are nonspecific cytologically, those which are caused by neoplasms may contain malignant cells which allow specific diagnosis. To maximize the likelihood of finding such abnormal cells, concentrated cellular preparations should be evaluated.

Modified transudates: The accumulation of transudative fluid in one of the body cavities causes increased pressure which is irritating to the mesothelial cells resulting in proliferation and sloughing into the effusion. With time these cells die and release chemotaxants drawing phagocytes into the effusion. The result is a mild increase in both total protein (30-50 g/L) and nucleated cell count (slightly more than 500x10⁶/L). When this occurs, the fluid is known as a modified transudate. Thus, modified transudates are nothing more than transudates which have been present long enough to illicit a mild inflammatory reaction. Eventually, characteristics of the fluid may change enough so that the fluid is classified as an exudate. The microscopic evaluation of the fluid generally provides critical information for correct interpretation.

Exudates: Exudates are defined as fluid accumulations which are abnormally high in total solids and/or nucleated cell count. Total proteins range between 30 and 70 g/L and total cell counts may be as high as 100,000x10⁶/L. The vast majority of exudates are caused by inflammation; however, the common denominator of exudate formation is vascular damage. Consequently, both hemorrhage and chylous effusions are classified as exudates on the basis of physical characteristics and pathogenesis.
Inflammatory exudates are classified like classic cytologic sample characterization. Because of local irritation, some degree of reactive mesothelial cell hyperplasia is present. Most inflammatory effusions are cytologically nonspecific in terms of etiologic diagnosis. Again, classic cytologic characterization of a sample is used to help either identify an underlying infectious agent or direct the veterinarian to additional diagnostic procedures.

Several fluid formations that do not typically follow this classification system and should be considered separately are discussed below.

**Feline infectious peritonitis (FIP):** FIP is unique among most exudates in that the fluid which accumulates is of low cellularity. Total protein content is typically extremely high, which is a reflection of a similar elevation in serum protein (polyclonal gammopathy). The cellular response is most commonly neutrophilic in character; non-degenerate neutrophils predominate. Low to sometimes significant numbers of normal small lymphocytes and macrophages may be seen also.

**Bile pleuritis/peritonitis:** Because bile is a very irritative substance, its presence very quickly elicits an inflammatory response. The cellular response is mixed with many neutrophils associated with the acute irritant but with a significant influx of macrophages present for removal of the foreign material and degenerating cells. Bile is seen as greenish to black granular material scattered in the slide background and in the cytoplasm of reactive mesothelial cells and macrophages. Reactively mesothelial hyperplasia is a common finding with these effusions.

**Parasitic effusions:** As expected, parasitic infections are often characterized by eosinophilic exudates. In dogs, the most common such effusion is the pleural effusion associated with heartworm disease. It should be emphasized that not all cases of parasitic effusion are characterized by eosinophilic exudates; in many cases the exudate is non-specific. A small number of non-parasitic infections can result in eosinophilic peritoneal or pleural effusions also. For example, we have seen such responses in association with systemic microcytosis in dogs, eosinophilic pneumonia in cats and a variety of neoplastic conditions including lymphoproliferative disease and various carcinomas in a variety of species.

**Chylous effusions:** Chylous effusions are the result of leakage of lymph into the body cavity and may involve either the pleural or peritoneal space. These fluids are often described as opaque milky fluids; however, it should be emphasized that depending on the lipid content and longevity of the fluid, they may be clear and colorless. Consistent characteristics include the finding of a high protein concentration (35-45 g/L) but relatively low cellularity. Cytologically, they are associated with significant numbers of normal appearing small lymphocytes but since the lipid is relatively irritating rather significant numbers (and potentially predominating numbers) of mature nondegenerate neutrophils as well as significant numbers of hyperplastic mesothelial cells can be present. It is important to note that in the cat, cardiac disease results in pleural effusions which are indistinguishable from chylothorax. The mechanisms behind these effusions have not been clarified; however, it is well established that heart failure causes venous and lymphatic stasis with increase pressure. In the cat it appears that these circumstances predispose to lymphatic leakage and result in a secondary chylous effusion.

**Hemorrhagic effusions:** True hemorrhagic exudates can occur in any of the major body cavities. Grossly, these effusions are red or serosanguineous depending upon the age of the exudate and the extent of the hemorrhage. Physical evaluation reveals a protein level reflective of but somewhat less than that of peripheral blood. Both nucleated cell counts and red blood cell counts are elevated. These fluids contain predominantly red blood cells with lesser numbers of nucleated cells. The most significant indicator of true hemorrhage is the presence of activated macrophages containing phagocyted red cells or hemosiderin. True hemorrhagic exudates are devoid of platelets but they are commonly observed in contaminated samples.

**Neoplastic effusions:** A variety of primary and secondary neoplastic processes involving the thoracic and peritoneal cavities can be seen in the dog and cat and clearly the microscopic identification of these neoplastic cells become diagnostic. The character of the fluid related to protein content and total cell count is dramatically variable.

### Selected References


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