Analysis of Canine Peritoneal Fluid Analysis

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KEYWORDS

• Canine peritoneal fluid analysis • Effusion criteria • Transudate • Exudate

KEY POINTS

- The proposed classification scheme for canine peritoneal fluid analysis appears more effective than more complicated schemes.
- Low-protein transudates were most often caused by severe liver disease or protein-losing enteropathy.
- High-protein transudates were most often caused by heart failure and neoplasia.
- Exudates were most often caused by septic abdomen and neoplasia.
- Neoplasia can result in effusions in all classifications, as can uroabdomen; hemorrhagic and chylous effusions often are classified as exudates, but can be transudates as well.

PURPOSE

There is occasional criticism of the traditional classification of effusions and it is not clear how the published recommendations were established. This retrospective review of cases was performed to see how well a large number of canine peritoneal fluid analyses fit into previously published guidelines and to determine if there may be a simpler, more effective way to use fluid analysis in helping develop a differential list and diagnostic plan of action for dogs with peritoneal effusion.

BACKGROUND

Normal body cavity fluid is of low cell and protein concentrations (<3000 cells/μL and <2.5 g/dL, respectively) and is present in very small amounts.[1] When the amount of body cavity fluid is increased, it is called an effusion. An effusion occurs either because of increased fluid entering the cavity or decreased removal. The type of fluid varies depending on the underlying cause. It may have characteristics very similar to the normally present fluid, or it may have increased cellularity, increased protein,

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and/or presence of atypical cells or other substances. A definitive diagnosis is often not possible from fluid characteristics alone, but knowing the type of effusion can help prioritize differentials and direct additional diagnostics.

The small amount of normal body cavity fluid comes from submesothelial capillaries. There is normally a free exchange of water, electrolytes, and small molecules that occurs between the intravascular and extravascular spaces, the rate of which is largely controlled by hydrostatic and oncotic pressures within the capillaries. There is normally a net filtration from the capillaries, the excess of which is picked up by lymphatics. The permeability of mesothelium is similar to that of capillaries; therefore, after passing out of capillaries, fluid that is not reabsorbed can pass freely through submesothelial interstitium into peritoneal and pleural spaces. The permeability of capillary endothelium and mesothelium to proteins and cells is normally low. The submesothelial lymphatic system includes direct openings to the body cavities (stomas), located between mesothelial cells, which are important in reabsorption of fluid, cells, proteins, and particles.[2,3]

An effusion, then, can form due to changes in hydrostatic forces within the arteriolar or venous ends of capillaries, imbalance of oncotic pressures between capillaries and interstitium, increased vascular or mesothelial permeability, or decreased lymphatic reabsorption of the fluid. Addition of fluid from other sources, such as leakage from the blood or lymphatic vasculature, urinary bladder, or biliary tract, can also result in an effusion. Of course, multiple factors may be present at the same time.

Transudates are often the result of changes in oncotic or hydrostatic pressure or decreased reabsorption; they have low total nucleated cell concentrations (TNCC) with variable total protein concentrations ([TP]) depending on cause and whether they arise before or after liver sinusoids. Oncotic pressure is largely dependent on plasma albumin concentration. Changes in capillary or lymphatic hydrostatic pressure can be systemic but are often more localized due to compression of vasculature from mass lesions or organ displacement, torsion, or distension, or due to intravascular blockage from thrombi or neoplasia. Exudates are most often associated with increased vascular permeability due to inflammation, resulting in high TNCC and [TP]. There are other fluids with increased cellularity that may not be exudates, technically, but, based on cell counts, we include them in the exudative category for convenience; these include neoplastic, lymphatic, and hemorrhagic effusions. Effusions caused by leakage of fluid from vessels or organs can result in variable fluid composition depending on quantity, chronicity, and other factors and therefore may fall into either the transudate or exudate category.

Effusions have traditionally been characterized based on TNCC and [TP], with cell types and a few other characteristics taken into account. In veterinary medicine, transudates are typically subcategorized as either a pure transudate or modified transudate. In small animals, the parameters recommended for pure transudates range from less than 1000 to 1500 cells/μL with less than 2.5 g/dL protein and those for modified transudates are a [TP] greater than 2.5 g/dL and TNCC either less than 5000 or from 1000 to 7000/μL.[4–6] Exudates are described as [TP] greater than 2.0, 2.5, or 3.0 g/dL and the TNCC as greater than 3000, 5000, or 7000/μL, depending on source.[4–8] In one source, modified transudates represent any fluid that does not fit their parameters for either a transudate (TNCC <3000/μL and [TP] <2.5 g/dL) or exudate (TNCC >3000/μL and [TP] >2.5 g/dL).[7] Another source uses a [TP] of 2.0 mg/dL to differentiate between low-protein and high-protein transudates.[8] Given the variability in pathologic processes, is it