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International Biomedical Inc.

Learning

Paired Analysis of D-Dimer and Its Correlated Hemostatic Parameters in 30 Dogs with Neoplasms after Tumorectomy

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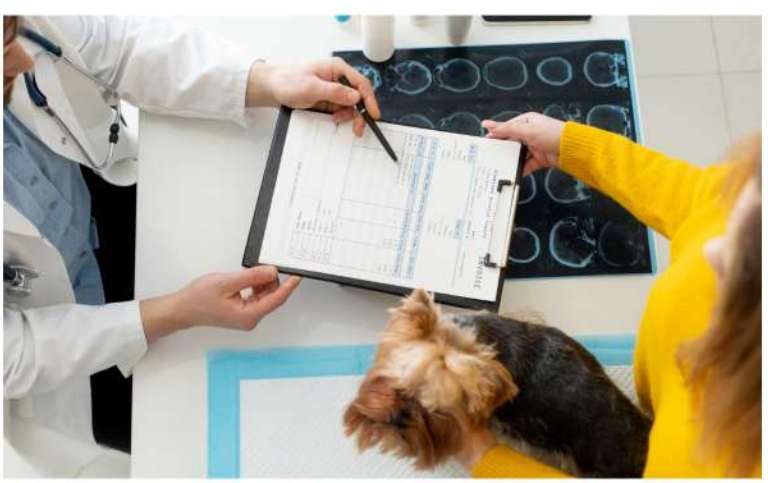
AmiShield
Veterinary Chemistry Analyzer

Introduction

Cancer biomarkers are valuable indicators used to classify tumors, assess their malignancy, and predict patient outcomes. These tumor-produced substances circulate in body fluids and often reflect cancer progression. Increasing research highlights a connection between cancer and blood clotting (hemostasis), with cancer patients often showing hemostatic dysfunction, which can lead to complications like pulmonary embolism (PE) and disseminated intravascular coagulation (DIC).

In veterinary medicine, D-dimer—an indicator of clotting activity—has shown potential as a cancer biomarker. Dogs with cancers such as lymphoma, carcinoma, and metastatic tumors show significantly elevated D-dimer levels compared to healthy dogs. Immunostaining also shows D-dimer deposits in tumor-affected tissues, reinforcing its potential as a biomarker for various tumor types in dogs.

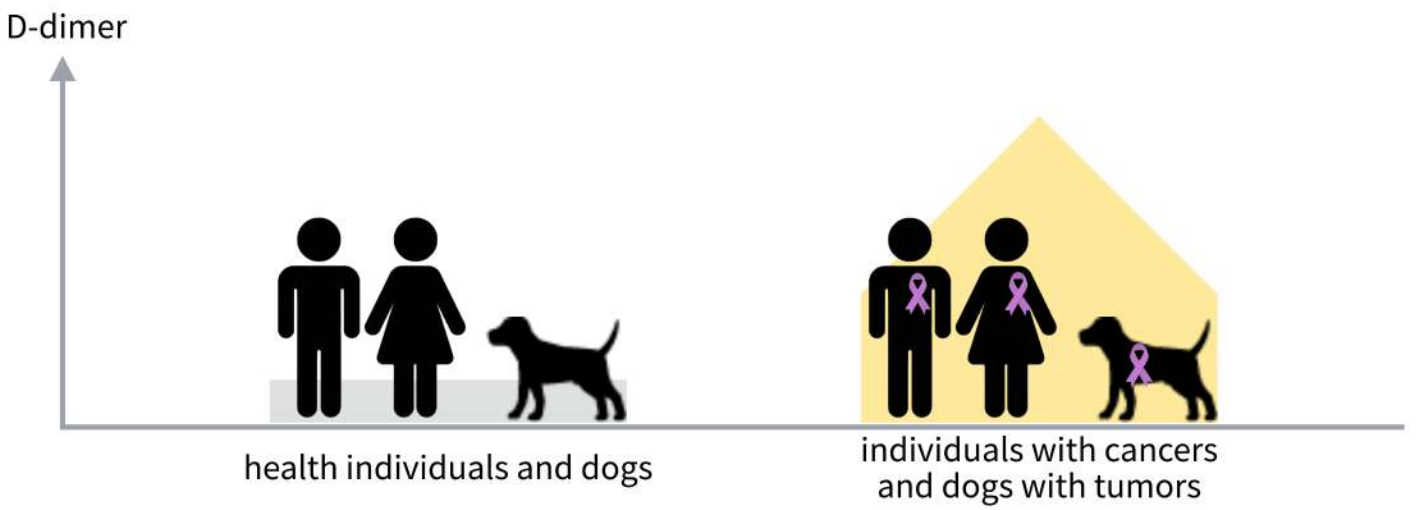
These findings support D-dimer as a promising marker for detecting and monitoring various types of tumors in dogs, though further research is needed to confirm its accuracy and broader clinical use. Overall, this study examined plasma D-dimer levels and other hemostatic parameters in 30 healthy dogs and 30 dogs with tumors, both before and after tumor removal (tumorectomy). The purpose was to explore potential tumor biomarkers in veterinary medicine by assessing factors like D-dimer, thromboelastography G (TEG G), fibrinogen, activated partial thromboplastin time (aPTT), prothrombin time, and platelet count. The findings highlight these values as[1] promising indicators for monitoring tumor presence and progression in dogs.



What and Why is D-dimer?

Coagulation (blood clotting) and fibrinolysis (clot breakdown) are processes that can be abnormally activated in tumors, promoting cancer growth and spread by aiding new blood vessel formation (angiogenesis). Cancer cells can induce a hyper-coagulable state, supporting tumor progression. Tumor-related inflammation also stimulates coagulation and fibrinolysis, further driving tumor growth, metastasis, and angiogenesis.

In response to this hyper-coagulable state, D-dimer—a byproduct of fibrin breakdown—has become a valuable marker in human medicine, as it reliably indicates active coagulation and fibrinolysis. Elevated D-dimer levels have been reported in several cancers, including colorectal, liver, lung, and gastric cancers. This connection has also been observed in veterinary medicine, where dogs with tumors often show higher D-dimer levels than healthy dogs, with levels rising alongside cancer severity.



Result

This study measured D-dimer levels in dogs with tumors before and after surgery to investigate its link to tumor burden. Before treatment, the median D-dimer level was 0.8 μg/mL (range: 0.1–6.3 μg/mL), which significantly decreased to 0.3 μg/mL (range: 0.1–3.7 μg/mL) after the tumor was removed (tumorectomy), showing a strong association between D-dimer levels and tumor presence ($p < 0.0001$). Despite this reduction, dogs with tumors still had significantly higher D-dimer levels compared to healthy control dogs, both before and after treatment.

Table 1: Different D-dimer concentration distributions in control individuals and dogs with specific tumor types before and after treatment.

	D-Dimer Concentration (μg/mL)				
	0.1–0.5	**0.5–1**	**1–2**	**2–3**	**> 3**
Control dogs (n = 30)	30	0	0	0	0
Dogs with neoplasms, pre-treatment (n = 30)	11	6	2	1	10
Mast cell tumor (n = 7)	3	2	-	-	2
Soft tissue sarcoma (n = 2)	-	-	-	-	2
Lipoma (n = 2)	2	-	-	-	-
Osteosarcoma (n = 1)	-	1	-	-	-
Fibrosarcoma (n = 1)	1	-	-	-	-
Transmissible venereal tumor (n = 1)	-	-	1	-	-
Mammary gland tumor (n = 7)	2	1	1	1	2
Anal sac tumor (n = 3)	1	1	-	-	1
Oral squamous cell carcinoma (n = 1)	1	-	-	-	-
Thyroid carcinoma (n = 1)	-	-	-	-	1
Melanoma (n = 4)	1	1	-	-	2
Dogs with neoplasms, post-treatment (n = 30)	17	2	4	5	2
Mast cell tumor (n = 7)	5	-	-	1	1
Soft tissue sarcoma (n = 2)	-	-	-	1	1
Lipoma (n = 2)	2	-	-	-	-
Osteosarcoma (n = 1)	1	-	-	-	-
Fibrosarcoma (n = 1)	1	-	-	-	-
Transmissible venereal tumor (n = 1)	-	1	-	-	-
Mammary gland tumor (n = 7)	3	1	2	1	-
Anal sac tumor (n = 3)	2	-	1	-	-
Oral squamous cell carcinoma (n = 1)	1	-	-	-	-
Thyroid carcinoma (n = 1)	-	-	1	-	-
Melanoma (n = 4)	2	-	-	2	-

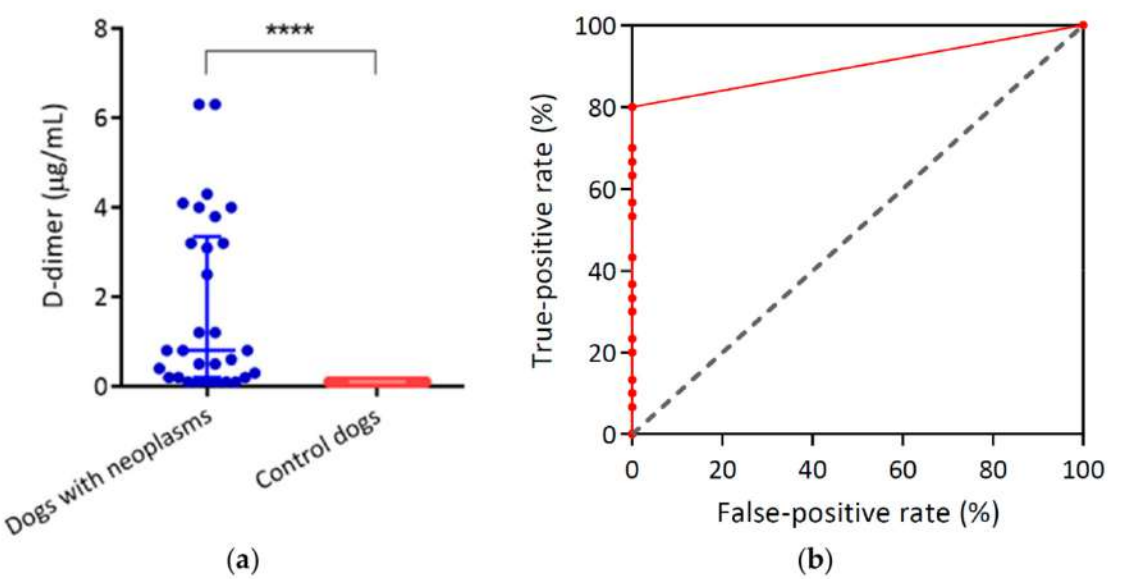


Figure 1: D-dimer concentrations in plasma of all dogs with neoplasma (n = 30) and control dogs (n = 30). (a) The median values of D-dimer in cancer and control dogs were 0.8 ± 3.15 and 0.1 ± 0.0 μg/mL, respectively ($p < 0.0001$); (b) The ROC curve of detection of D-dimer. The area under the ROC curve (AUC) is 0.90 under a 95% confidence interval of 0.8116–0.9884, with significant difference ($p < 0.0001$). ****, $p < 0.0001$.

Note: The table 1 and figure 1 are adapted from "Paired Analysis of D-Dimer and Its Correlated Hemostatic Parameters in 30 Dogs with Neoplasms after Tumorectomy", by Ke, C.-H.; Liu, C.-C.; Wang, S.-L.; Lin, C.-S., Animals 2023, 13, 969. https://doi.org/10.3390/ani13060969

Summary of Key Points

1. Elevated D-dimer Levels: This study found that dogs with tumors typically have higher levels of D-dimer, a marker associated with coagulation.
2. Post-Operative Decrease: After undergoing tumorectomy, the levels of D-dimer and fibrinogen in dogs significantly decreased, indicating a response to the surgical treatment.
3. Association with Tumors: Elevated fibrinogen levels were specifically observed in dogs diagnosed with mammary carcinoma, lymphoma, and sarcoma, linking these markers to particular types of tumors.
4. Impact of Metastasis: Dogs with distant metastatic tumors exhibited higher levels of both D-dimer and fibrinogen compared to those without invasive tumors, suggesting a relationship between metastasis and increased coagulation markers.
5. Lack of Correlation with Other Tests: The study found no correlation between disease progression and other hemostatic parameters such as activated partial thromboplastin time (aPTT), prothrombin time (PT), or platelet count (PLT). This indicates that D-dimer and fibrinogen may be more relevant indicators of tumor burden than these other measures.

Overall, further research is necessary to address these limitations and enhance our understanding of hyper-coagulability in dogs with tumors.

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Conclusion

In conclusion, this study evaluates the clinical significance of paired pre- and post-operative analysis of D-dimer and related hemostatic parameters in the same canine patients. The results demonstrated that D-dimer levels were elevated in dogs with tumors and decreased significantly following surgical removal, suggesting D-dimer as a potential biomarker for tumor presence. Additionally, changes in D-dimer, TEG G, fibrinogen, and aPTT levels may serve as indicators of tumor burden, although further research is necessary to confirm their accuracy and clinical utility. This study provides evidence that these hemostatic parameters hold promise as tumor biomarkers in veterinary medicine.

♦ Reference

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1. Ke, C.-H.; Liu, C.-C.; Wang, S.-L.; Lin, C.-S. Paired Analysis of D-Dimer and Its Correlated Hemostatic Parameters in 30 Dogs with Neoplasms after Tumorectomy. Animals 2023, 13, 969. https://doi.org/10.3390/ani13060969

AmiShield D-Dimer Disc

AmiShield D-Dimer disc provides quantitative determinations of D-Dimer in lithium heparinized whole blood or plasma. It can help veterinarians diagnosing these disorders: Disseminated intravascular coagulation (DIC), thromboembolic disease (TED), hemorrhage, pulmonary thromboembolism, trauma, sepsis, neoplasia, vascular disease, rheumatoid arthritis (RA), etc.

Here is the reference ranges for canines.

	D-Dimer (μg /mL)
Normal	0.15 - 0.5
may develop minor or severe blood clots	> 0.5