In Silico Model for Tumor Diagnosis Based on Bloodstream Penetrating Extracellular Vesicles

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Introduction

Extracellular Vesicles (EVs) are a common biomarker to detect tumors. EVs are tiny lipid-bound particles, 30 nm to 5 µm in size, released by cells. By modeling the flow of EVs in tissue and bloodstream in silico, we are now able to derive the progress of a tumors size, even for very small tumors with a size of 50 nm [**?**].

- Lack of research in EV transportation through barriers of tissue.
- The use of in silico models as cost-effective alternatives to in vivo or in vitro experiments is mentioned in both.

System Model

- Both describe the same realistic biological scenario with distinct zones: the artery (blood inlet), vein (blood outlet), capillary network (Ω_c), tumor area (Ω_t), and healthy tissue (Ω_h)
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Results

- Strong buildup of EVs in tumor regions due to dense tissue structure and lower diffusion rates, leading to significant barriers for capillary access.
- Inverse relationship between tumor size and the rate at which tumor-derived EVs enter the bloodstream. Shown in Figure 3.
- Small tumors (200 µm) release EVs rapidly, peaking at approximately 18 hours
- Larger tumors (600 µm) produce weaker signals, with peak amplitudes reduced by 60% and slower rise times .

Conclusion

- In silico framework offers a promising avenue for non-invasive cancer detection using circulating EV profiles, with potential sensitivity down to 50 µm, which is below the threshold of conventional imaging modalities.
- The temporal evolution of EV release is presented as a new diagnostic dimension beyond static imaging, enabling early detection.

Figure 1

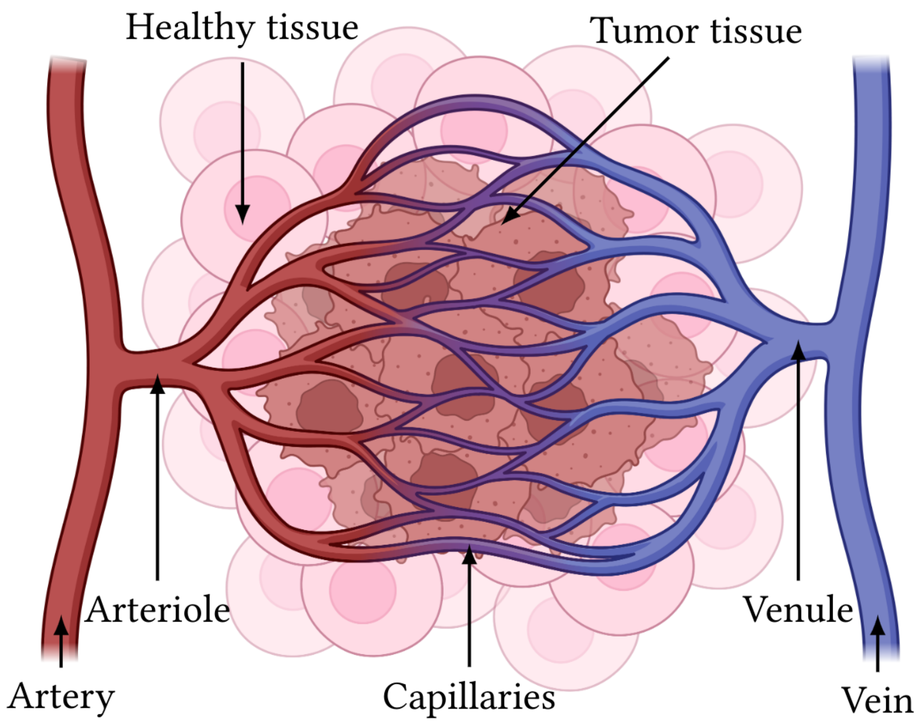


Figure 2

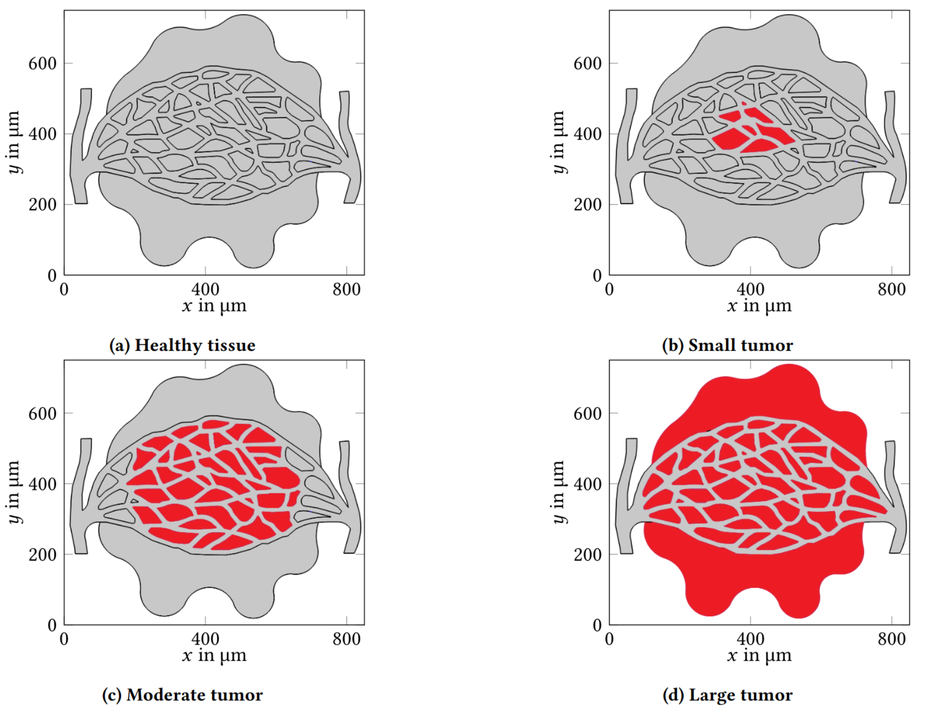
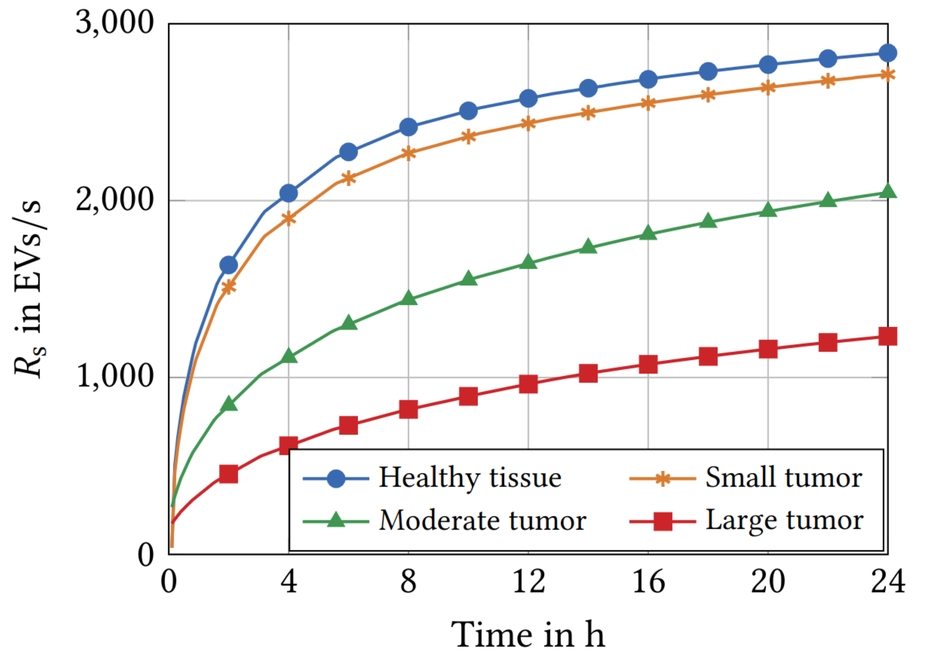


Figure 3



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