



Thermo-Fluid Dynamics Laboratory

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● Research Outline

Medical information technologies, for example Computer Tomography (CT) and Magnetic Resonance Imaging (MRI), have recently achieved remarkable development, and made highly detailed information inside human body with minimal-invasively. Such the information are now utilized medical diagnosis and development of new therapeutic approaches for various diseases. We have researched mass and heat transfer phenomena inside human body using both the medical information technology and computational fluid dynamics (CFD) simulation.

Heat & mass transfer inside nasal cavity – numerical evaluation of aerosol treatment efficacy: Aerosol treatment has been used for nasal diseases such as paranasal sinusitis, hypertrophic rhinitis and inferior concha inflammation. The effectiveness of the aerosol treatment has been confirmed from clinical view points until now. However there are a few researches that evaluate the effect of the nebulizer treatment theoretically and quantitatively, i.e., how medicinal mist transports and deposits on inflammation areas of nasal wall. Past researches for intranasal transport phenomena dealt with only a few cases even though there are individual differences in the shape of human nasal cavity. We has constructed three-dimensional geometry models of nasal cavities using five and more actual patient’s CT data. In addition CFD analysis for heat and mass transfer inside nasal cavity have been executed.

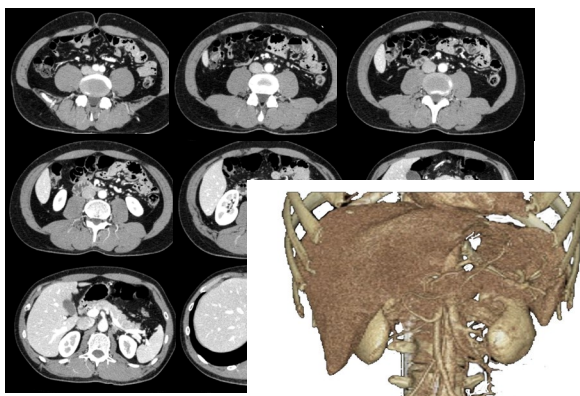


Fig. Patient’s abdominal CT and 3-D model

Hemodynamics analysis for hepatic portal vein – numerical simulation for blood-flow balance changes before and after PTPE: Controlling postoperative course is serious problem in percutaneous trans-hepatic portal embolization (PTPE). The embolization changes hemodynamics (blood flow balance) in the operated liver, subsequently brings on local and overall swellings of the liver. In some cases the liver failure is occurred by the operations. In order to prevent the failure prediction method is required before the PTPE surgeries quantitatively and numerically. We have developed numerical model for hemodynamics analysis in hepatic portal vein; geometric models are made from patient’s CT image data before and after the PTPE and performed Computational Fluid Dynamics (CFD) analysis.

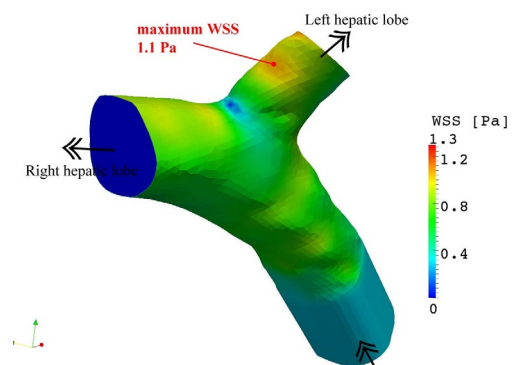


Fig. Wall share stress at main branch of hepatic portal vein

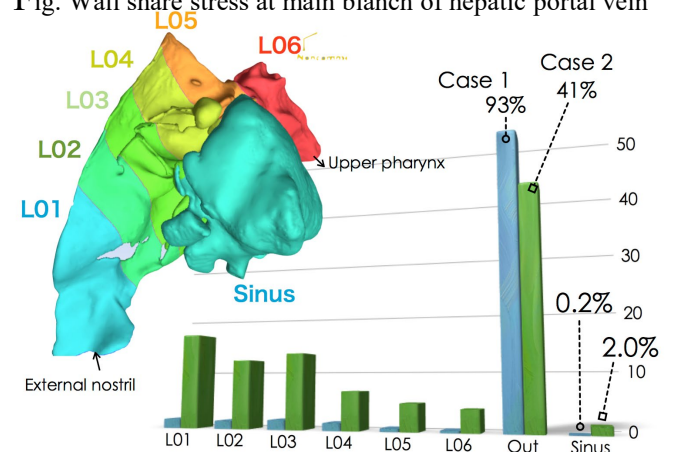


Fig. Aerosol deposition characteristics inside nasal cavity