Hybrid mesh for nasal airflow studies

Abstract

The accuracy of the numerical result is closely related to mesh density as well as its distribution. Mesh plays a very significant role in the outcome of numerical simulation. Many nasal airflow studies have employed unstructured mesh and more recently hybrid mesh scheme has been utilized considering the complexity of anatomical architecture. The objective of this study is to compare the results of hybrid mesh with unstructured mesh and study its effect on the flow parameters inside the nasal cavity. A three-dimensional nasal cavity model is reconstructed based on computed tomographic images of a healthy Malaysian adult nose. Navier-Stokes equation for steady airflow is solved numerically to examine inspiratory nasal flow. The pressure drop obtained using the unstructured computational grid is about 22.6 Pa for a flow rate of 20 L/min, whereas the hybrid mesh resulted in 17.8 Pa for the same flow rate. The maximum velocity obtained at the nasal valve using unstructured grid is 4.18 m/s and that with hybrid mesh is around 4.76 m/s. Hybrid mesh reported lower grid convergence index (GCI) than the unstructured mesh. Significant differences between unstructured mesh and hybrid mesh are determined highlighting the usefulness of hybrid mesh for nasal airflow studies.

Keyword: Flow rate; Hybrid mesh; Mathematical phenomena; Nose airflow; Nose cavity; Velocity