

EXPERIMENTAL VERIFICATION OF OPTIMIZED COOLING OF HUMAN HEARTS FOR TRANSPLANT SURGERY

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This paper presents the progression and process of developing and testing an artificial heart, with thermal and geometrical properties as close as possible to those of a real human heart, for the purpose of experimentally verifying a computer model for heart cooling. Upon the failure of the artificial heart model, the team obtained approval to conduct testing on a porcine heart. Information pertaining to research, funding, design, fabrication, and testing necessary for the execution of this project are included in the report, along with the design of the cooling system and testing apparatus. Several other relevant observations and explanations concerning necessary simplifications in the heart model are also included. Our main objectives were as follows:

1. Construct an approximate geometric model of the human heart from a material which emulates its thermal properties accurately.
 - The use of a manufactured model is ideal because the material properties would be homogenous throughout the model, which would be consistent with the computer model being used as reference.
 - If a heart cannot be successfully manufactured, a pig heart will be used. Pig hearts are very similar to human hearts but are not as easy to predict computationally.
2. Develop a testing apparatus suitable for housing the model heart. This apparatus will include the pump, containers, hoses, and attachments of the cooling system, and thermocouples and flow meter necessary to track the temperature and flow rate of the cooling fluid through the model and temperature of the model itself at various points.
3. Test the artificial (or animal) heart with external cooling alone and with internal and external cooling together, and compare results first to each other, and then to data gathered from similar studies done on computer models.

In the end, the computational model was not able to be verified, but the first two project objectives were met with success. Methods for creating the artificial heart were pursued extensively before the team sought out approval for porcine heart use. The testing apparatus operated as desired. Moreover, valuable insight into the design of a system for such verification was gained, as well as knowledge pertaining to the human circulatory system.