AN ANALYSIS OF MUSCLE MECHANICS WITH APPLICATION TO FLOWS FROM MUSCLE-WALLED TUBES

BY

L.M. MARTIN B.Sc (Hons.)(Adel.)

Thesis submitted for the degree of Master of Science in the University of Adelaide
Department of Applied Mathematics
March 1975.

SUMMARY

The thesis describes several mathematical models for muscle contraction and examines the viscoelastic properties of some of these. In particular, the work of Apter and Graessley (1970) and Helfgott et al. (1972) is discussed and applied to the modelling of various physiological systems.

The muscle tube and linear flow model proposed by Helfgott et al. has been extended to include a generalized impedance at the outlet, permitting more accurate modelling of blood flow from the heart into the arterial system in the body. In the special case of a matched impedance at the outlet of the tube, outflow velocity and the volume of fluid expelled in one contraction of the muscles, are found for some simple excitation signals.

The matched impedance model is also applied to the study of some idealized diseases. Two types of defective muscle tubes are discussed. The first type has a segment containing muscles which are no longer elastic and so this portion remains rigid when the activation signal passes along the tube, causing the other muscle fibres to contract. The other type of defect considered occurs when a part of the muscle tube is not stimulated, but the elasticity is unaffected. In both cases, velocity profiles and fluxes are computed and compared with the results obtained for a non-defective muscle tube.

SIGNED STATEMENT

The contents of this thesis have not been submitted to any university for the purpose of obtaining any other degree or diploma. Also, to the best of my knowledge, the thesis contains no material previously published by any other person, except where due reference is made in the text.

(L.M. Martin)

ACKNOWLEDGEMENT

I am indebted to my supervisor, Professor E.O. Tuck for his encouragement and critical advice during the period of this research. I would also like to thank both Mr. A. Helfgott, for showing interest in this work, and Miss D.J. Potter for her efficient typing of the manuscript.

L.M. Martin

CONTENTS