GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[X] ORIGINAL [ ] REVISION NO. _____

Project No. E-16-D05 GTRI/GIT DATE 8 /02 /83

Project Director: Don P. Giddens School/Lab AE

Sponsor: DHHS/PHS/National Heart, Lung, and Blood Institute

Type Agreement: Grant No. 5 R01 HL22635-05

Award Period: From 7/1/83 To 11/30/84 (Performance) _____ (Reports)

Sponsor Amount:	This Change	Total to Date
Estimated: $		$ 115,646*
Funded: $		$ 115,646*

Cost Sharing Amount: $ 5,977 Cost Sharing No: E-16-328

Title: "Hemodynamics of Normal and Diseased Carotid Arteries"

ADMINISTRATIVE DATA OCA Contact John W. Burdette X4820

1) Sponsor Technical Contact:

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Defense Priority Rating: N/A Military Security Classification: N/A

(or) Company/Industrial Proprietary: N/A

RESTRICTIONS

See Attached NIH Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval – Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with None proposed

COMMENTS:

Continuation of E-16-D04

*Includes unobligated balance of $1,441 plus applicable overhead transferred from E-16-D04.

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FORM OCA 4-383

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 11/25/86

Project No. E-16-D05 School AE

Includes Subproject No.(s)

Project Director(s) Don P. Giddens GTRC/ GIT

Sponsor DHHS/PHS/National Heart, Lung, and Blood Institute

Title "Hemodynamics of Normal and Diseased Carotid Arteries"

Effective Completion Date: 11/30/84 (Performance) 2/28/85 (Reports)

Grant/Contract Closeout Actions Remaining:

- ☐ None
- ☐ Final Invoice or Final Fiscal Report - already submitted
- ☐ Closing Documents
- ☐ Final Report of Inventions - already submitted
- ☐ Govt. Property Inventory & Related Certificate
- ☐ Classified Material Certificate
- ☐ Other

Continues Project No. E-16-D04 Continued by Project No.

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FINAL PROGRESS REPORT

Hemodynamics of Normal and Diseased Carotid Arteries

Grant No. HL22635
Period Covered: September 1, 1978 to November 30, 1984

Don P. Giddens
Georgia Institute of Technology

FINAL PROGRESS REPORT

The objectives of this study were to determine the nature of flow disturbances which occur distal to arterial stenoses and to employ this knowledge to aid in the detection and quantification of atherosclerotic plaques. Extensive experiments were performed to measure flow velocities in steady and pulsatile flows through models with axisymmetric constrictions and in a model of the human carotid bifurcation, as well as acute in vivo studies of coarctations in canines.

The stenosis experiments revealed three types of flow disturbances: (i) a coherent structure associated with the starting phase of each cycle; (ii) laminar oscillations of essentially discrete frequencies originating from the shear layer; and (iii) turbulence, characterized by random velocity fluctuations. These studies show that non-turbulent flow disturbances are the first to occur as the degree of stenosis increases, implying that coherent disturbance phenomena rather than turbulence may be an important key to improved detection of localized atherosclerosis.

The carotid artery model studies were performed only upon a model of the normal bifurcation since funding expired before the research had reached the stage of examining models with simulated plaques. The experiments showed that: (i) large regions of transient flow separation, reversal and helical patterns exist in the carotid bifurcation; (ii) turbulence (i.e., velocities with random behavior) does not occur under physiologic conditions in the carotid bifurcation; (iii) correlation with human disease demonstrated that atherosclerotic plaques localize in regions of low mean wall shear and oscillating shear, not in regions of high shear. Additionally, comparison of the model studies with data obtained from normal human subjects using ultrasonic duplex scanning methods showed convincingly that the model experiments correctly predicted the flow behavior found in vivo.

In companion studies of Doppler ultrasound techniques it was shown that: (i) tracking the Doppler signal with a phase lock loop frequency tracker gives very good velocity measurements for normal flows and for disturbed flows which are coherent or moderately turbulent (intense turbulence could not be followed accurately); (ii) the first moment approach to estimate velocity is accurate for pulsed Doppler systems with small sample volumes; (iii) autoregressive methods of spectrum estimation appear to be very promising as an improvement over Fourier methods.

Thus, the research identified those flow disturbances which first occur as a plaque develops and improvements in Doppler ultrasound signal processing were demonstrated which are necessary to measure flow velocity with sufficient accuracy that small disturbances can be detected. Unfortunately, funding for the project was discontinued so that these new basic findings have not been applied to actual human investigations.