TABLE I.
Vagotomy in Chronic Ulcerative Colitis.

Case No.	Age	Duration, yrs	Complic.	Completeness of vagotomy	Results		
					Sympt.	Procto	X-ray
726638	20	7	6 ft. intest.	Incomplete	Temporarily excellent	——	——
647070	57	10	—	Complete	Excellent	Healed	Imp.
771995	14	2	Poliomyelitis	"	"	"	"
620076	57	13	——	"	Imp.	"	Neg. before
703015	44	5	D.U.	Incomplete	Equivocal	Neg. before	" "

sults have been obtained in those cases in which the insulin gastric analysis indicated that section of the vagus had been complete.

In the first case a severe tachycardia followed operation and persisted 2 weeks with electrocardiographic changes suggesting pericarditis. Electrocardiograms were therefore done before and after surgery to determine whether vagal section 4 to 5 cm above the diaphragm consistently cause electrocardiographic alterations. None were found except that one case has a sinus bradycardia (58 as against 70 preoperatively).

Stool examinations indicate that the pus, uniformly present in the stool preoperatively, disappeared postoperatively in 2 of those cases in which section was proved to be complete. In the third, pus was only occasionally present 3 months after operation, but some blood was consistently present.

Of particular interest is the transit time of material through the gut. No significant difference was observed except in the patient who had had 2 to 7 stools a day before surgery; in her case the transit time was 6 hours at that time. Four months after vagotomy it was 26 hours and she had dropped to one stool a day, formed.

Conclusion. Preliminary investigation indicates that vagotomy offers sufficient promise in chronic, nonspecific, ulcerative colitis to justify further investigation.

15944 P

Demonstration of a Positive Relationship Between Cardiac Output and Oxygen Consumption.*

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The purpose of this paper is to demonstrate a positive relationship between oxygen consumption and cardiac output. In order to accomplish this, a method of measuring cardiac output was needed in which the calculation of the cardiac output did not include the factor of oxygen consumption. For this reason the ballistocardiograph was selected, and Starr's[1] "height" formula was used on the tracings obtained on a high frequency table. The oxygen consumption was measured on the tracings obtained from a Benedict-Roth metabolism apparatus and all data was divided by the individual surface area.

Medical students, laboratory workers, and resident physicians were subjects of this study, and all were purposely studied under nonbasal conditions. Measurements of the

* This work was carried out under a contract between the Office of Naval Research and the University of Rochester School of Medicine and Dentistry.

1 Starr, I., and Schroeder, H. A., *J. Clin. Invest.*, 1940, **19**, 437.

TABLE I.

Data analyzed	No. cases	Coefficient of determination in %*	Correlation coefficient r	Significant	% change in output for each 10% increase in O_2 cons.
Cournand	34	51	.713	Yes	7.22
Brown and Pearson	42	30	.545	"	6.54
Stead and Warren	26	47.5	.689	"	5.92
Starr	48	16	.418	"	8.63

* The coefficient of determination denotes the amount of variability in cardiac output that can be explained by the one factor studied, namely oxygen consumption.

cardiac output were made just before and just after two 6-minute periods in which oxygen consumption was measured. The results were then averaged.

Forty-two records were then analyzed and a positive relationship obtained. The correlation coefficient was determined as .545, a significant relationship statistically. Furthermore, by calculating the regression equation the ratio of change was determined. It was found that for each 10% increase in oxygen consumption a 6.54% increase occurred in cardiac output.

To further substantiate this relationship, published data (using other methods of measuring cardiac output and oxygen consumption) were analyzed similarly. In these cases patients were under basal conditions Using data published by Cournand[2] in which cardiac output was determined on 34 cases employing right heart catheterization technic, and oxygen consumption by the analysis of expired air, a positive correlation coefficient of .713 was obtained. The regression equation was calculated and it was found that for a 10% increase in oxygen consumption a 7.22% increase occurred in cardiac output.

In 26 cases published by Stead[3] using the same procedures as Cournand for the determination of cardiac output and oxygen consumption a positive correlation coefficient of .689 was obtained. The regression equation revealed that for each 10% increase in oxygen consumption an increase of 5.92% occurred in cardiac output.

One other series of data was analyzed in which cardiac output was determined by the ethyl iodide technic and oxygen consumption from analysis of expired air. In 48 cases published by Starr[4] a positive correlation of .418 was obtained. Although, lower than the other methods, the value obtained is significant statistically. The calculation of the regression equation reveals that for a 10% increase in oxygen consumption an increase of 8.63% occurs in cardiac output.

A summary of the results appears in Table I.

The average value obtained by the 4 observers and 3 methods of measuring cardiac output shows that for each 10% increase in oxygen consumption a 7.07% increase occurs in cardiac output. Furthermore, the differences between the percentages tabulated are not significant statistically.

Conclusions. 1. Regardless of the methods used in measuring cardiac output and oxygen consumption a significant positive relationship was demonstrated for 3 different methods between oxygen consumption and cardiac output. 2. Maximum variation explicable in cardiac output by variation in oxygen consumption was approximately 50%. This coefficient of determination reveals that only one-half of the variance in cardiac output could be explained by changes in oxygen consumption. The amount of variation in cardiac output explicable by oxygen consumption might be improved if in addition to basal conditions, uniform environmental temperature and humidity were maintained during the study. 3. The calculation of the regression equation for each series of data dem-

2 Cournand, A., Riley, R. L., Breed, E. S., Baldwin, E. deF., and Richards, D. W., Jr., *J. Clin. Invest.*, 1945, **24**, 106.

3 Stead, E. A., and Warren, J. V., *J. Clin. Invest.*, 1945, **24**, 326.

4 Starr, I., Collins, L. H., Jr., and Wood, F. C., *J. Clin. Invest.*, 1933, **12**, 13.

onstrates a striking constancy of change. Despite variance in methods for determining cardiac output and oxygen consumption, and varying basal or nonbasal conditions of the subjects, the ratios of change are the same. For each 10% increase in oxygen consumption an average increase of 7.07% in cardiac output results. 4. Relative changes in cardiac output are the same regardless of whether one uses the ballistocardiograph, right heart catheterization, or ethyl iodide method in the determination of cardiac output.

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The Culture of Tissue Cells in Clots Formed from Purified Bovine Fibrinogen and Thrombin.*

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The plasma clot has long been accepted as the most satisfactory support for the growth of tissue cells *in vitro*. Presumably the strands of fibrin form a meshwork along which the cells migrate and by which they maintain a distribution and spacing which permits the free intercellular diffusion of nutrients and metabolites. Regardless of the precise relationship between cells and clot, their growth in the plasma coagulum is better than on any other supporting surface.[1]

As the source of coagulum, chicken plasma has been most favored. The clot formed is firm and transparent and is more resistant to the lytic effect of tissue explants, particularly those of heterologous origin, than are clots of other whole plasmas.[2-4] There are, however, several undesirable features connected with its use. There are obvious problems inherent in the collection and storage of chicken plasma. There are considerable variations in clotting properties and in the influence of the plasma on culture growth which apparently are related to the age and health of the donor.[5] Whole plasma is, moreover, of complex and, to a great extent, unknown composition. Finally, it can be the medium of transmission of infectious agents, especially viruses.[6-9] What is required, then, is the source of a clot or its equivalent more conveniently obtained than chicken plasma, free of complicating infectious agents, and acceptable to the cells as a supporting structure.

The methods for the fractionation of plasma proteins developed in the Department of Physical Chemistry of the Harvard Medical School have made available many of the proteins of both human and bovine blood plasma in states of greater purity and in larger amounts than could have been obtained

* The initial results of these studies were described at the Hershey Conference on Tissue Culture, sponsored by the Committee on Growth of the National Research Council and held at Hershey, Pa., November 10-13, 1946.

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2 Parker, R. C., *Methods of Tissue Culture*, New York, Paul B. Hoeber, Inc., 1938.

3 Carrel, A., and Ebeling, A. H., *J. Exp. Med.*, 1928, **48**, 105.

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5 Carrel, A., and Ebeling, A. H., *J. Exp. Med.*, 1921, **34**, 599.

6 Furth, J., *J. Exp. Med.*, 1932, **55**, 465.

7 Doyle, T. M., *J. Comp. Path. and Therap.*, 1927, **40**, 144.

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9 Burmeister, B. R., Prickett, C. O., and Belding, T. C., *Cancer Res.*, 1946, **6**, 189.