this study. It was found to be feasible and helpful in the organization of the cases and as a guide to the proper treatment of the individual patient.

The incidence of secondary cervical metastases was 70% in cancers of the pyriform sinus and 50% in those in the posterior-lateral wall of the hypopharynx and the postcricoid area. Fixed cervical nodes had a very gloomy prognostic significance, and in most cases the only proper objective in these patients was palliation.

Survival rates from treatment of hypopharyngeal cancers in this series compared favourably with those of other major centres, but still they cannot be considered to be satisfactory. The elective use of preoperative irradiation in the first, second and third stages of the disease is most likely to bring about an improvement in results.

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Hematocrit and Coronary Heart Disease

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ABSTRACT

Hematocrit values of patients with acute myocardial infarction have been reported by some workers to be higher than those found in controls; this has been denied by others. In these reported studies important postural, postprandial, age and stress effects have not been considered. In the present investigation hematocrits of healthy and coronary subjects were determined under the same "standard basal" conditions, in the morning hours, fasting or after a light breakfast, and in sitting position; patients studied had no acute illness or distress. A mean hematocrit of 49.1 ± 2.4% was observed in 66 men with chronic coronary disease and of 46.8 ± 3.2% in 68 healthy controls of the same age and sex, the difference being highly significant. The increased hematocrit and plasma viscosity in coronary patients creates significantly higher whole blood viscosity than that observed in healthy controls. This hemodynamic factor may be responsible for the development of clinical symptoms of coronary heart disease and possibly of the basic vascular disease itself.

SOMMAIRE

Certains cliniciens ont signalé que les valeurs de l'hématocrite chez des malades souffrant d'infarctus aigu du myocarde étaient plus élevées que celles constatées chez des sujets-témoins; ce fait a été nié par d'autres chercheurs. D'après les travaux qui ont été publiés, les répercussions de la position du malade, des repas, de l'âge et du stress n'ont pas été considérés. La présente étude s'est assignée comme but de déterminer la valeur de l'hématocrite chez des sujets sains et des coronariens dans les mêmes conditions "standards", c'est-à-dire aux heures de la matinée, le sujet étant à jeun ou ayant pris un léger petit déjeuner, et en position assise; les malades observés n'avaient aucun malaise ni aucune maladie aiguë. Une valeur moyenne de l'hématocrite de 49.1 ± 2.4% a été trouvée chez 66 hommes atteints d'affection coronaire chronique et de 46.8 ± 3.2% chez 68 sujets-témoins du même âge et du même sexe: la différence est très sensible. L'augmentation de la valeur de l'hématocrite et de la viscosité plasmatique chez les coronariens crée une viscosité du sang total nettement plus élevée que celle observée chez les sujets sains. Ce facteur hémodynamique peut expliquer le développement de symptômes cliniques d'une affection coronarienne et, peut-être, la maladie vasculaire fondamentale elle-même.

BURCH and DePasquale[1, 2] reported that male and female patients suffering from acute myocardial infarction have higher hematocrit (HCT) levels than do control subjects of the same sex and age, and suggested that this factor could have some bearing on the development of this condition. Conley *et al.*,[3] however, presented evidence that the HCT of male patients with acute myocardial infarction did not differ significantly from that of healthy controls. Since this controversy is

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not only of academic interest but has important clinical implications in the possible prevention and treatment of this serious condition, we have studied the problem by comparing the HCT of healthy volunteers and of patients with chronic coronary heart disease under meticulously controlled "standard basal" conditions.

MATERIAL

The HCT of 68 apparently healthy male employees of a hospital and university staff was measured. Their age range was from 35 to 62 years, the mean being 50.8 years. They were performing duties requiring light physical activity and had no history of cardiovascular or other disease. None of this group had ever donated blood. They were known to the author for two to six years prior to and for one to three years after this study. HCT values were also obtained from 66 male patients with unequivocal evidence of chronic coronary heart disease. The age range of this group was from 37 to 64 years, the mean being 51.5 years. All of these patients were ambulatory and had no distress except for exertional angina relieved by nitroglycerin or rest. Twenty-four of the group had unequivocal evidence of acute myocardial infarction and had been treated in the Kingston General Hospital more than one year prior to this study. Some of these patients received anticoagulant drugs during the acute stage of infarction but none was on long-term anticoagulant therapy. As far as we were aware, they did not suffer from pulmonary disease or conditions associated with bleeding episodes. They were not following any dietary regimen and did not take drugs other than nitroglycerin or long-acting nitrates. At the time of the HCT determination they had no angina and did not take nitroglycerin. These patients were seen in the office or were hospitalized for evaluation of their heart disease. The socio-economic status of the controls and coronary patients did not show any significant differences.

METHOD

The volunteers walked to the laboratory in the morning hours after a light breakfast, and then remained seated for at least 30 minutes before tests were performed. Blood was taken through a 19-gauge needle in a dry syringe from the antecubital vein after application of a tourniquet for no longer than 15 seconds. The sample was transferred to a Vacutainer tube containing 10 units of dry heparin per ml. of blood. The tube was placed in a slowly rotating mixer for 10 to 20 minutes to keep the sample well mixed. The duplicate microhematocrit (HCT) determinations were performed immediately after this mixing period in a high-speed Drummond centrifuge according to the technique of Strumia, Sample and Hart.[4]

RESULTS

Table I shows the mean and SD of HCT readings of controls and of ambulatory patients. The age range and the mean age are comparable in both groups. The mean HCT of the coronary patients was higher than that of healthy controls and the difference is significant at less than 0.1% level.

TABLE I.—HEMATOCRIT OF HEALTHY SUBJECTS AND PATIENTS WITH CHRONIC CORONARY HEART DISEASE (AMBULATORY MALE SUBJECTS)

	Healthy	*Coronary*	*Significance of the difference between means*	
n	68	66	t	p
Age range (yr.)	35-62	37-64	-	-
Mean age	50.8	51.5	.57	0.6
±SD (yr.)	±7.3	±6.7		
HCT %	46.8	49.1	4.68	0.001
±SD	±3.2	±2.4		

DISCUSSION

In evaluating the role of HCT in the development of acute myocardial infarction it should be noted that laboratory tests obtained during the acute phase of myocardial necrosis do not necessarily reflect the pre-infarction values, since HCT, like the blood sugar and cholesterol, may be grossly abnormal during the stress of acute illness, heart failure or shock. For such an evaluation one should use data obtained some months or years prior to the acute illness. Data from patients with typical angina can also be used, since many of these individuals will have myocardial infarction sooner or later. An alternative is to include patients who already had myocardial infarction provided that they are not on any drug or dietary regimen which may influence the HCT.

Before discussing our results we would like to stress that environmental factors independent of any disease may affect the HCT and lead to controversial findings. Several studies, including our own,[5-8] have indicated that the HCT increases significantly in the erect position or after moderate walking as compared with recumbent readings, and decreases after the consumption of an 800-calorie meal. We have stressed the necessity of taking blood for HCT from patients in a "standard basal" condition: in the morning hours fasting or after a light breakfast and after sitting for at least 30 minutes before the blood test.[8] Furthermore, the age of the subjects should also be considered, since we reported (as did Strumia[9]) that young healthy male university students (21 to 26 years of age) have significantly higher HCT readings than older healthy males (35 to 60 years).[10] Knowledge of these important postural, postprandial and age effects may place the controversial reports in the proper perspective.

The healthy controls in the study reported by Conley *et al.*[3] were 30 years younger than the coronary patients; they were ambulatory and very likely were sitting when blood was withdrawn. The erect posture, possible moderate walking before the test, and the younger age of subjects in this group yielded higher readings than one would have obtained from controls of older age in the recumbent position. The coronary group consisted of acutely ill patients at bed rest. The fact that they were significantly older than the controls and were in recumbent position (the value of the first HCT taken during their acute illness was used in the study) reduced their HCT at the time of the test. In other words, their HCT might have been significantly higher in the erect position one day, month or year prior to the acute myocardial infarction. Conley *et al.*[3] realized the possible effect of acute illness on HCT and reported 54 patients in whom the mean HCT was 46.7% at various intervals before the acute infarction, 45.6% during the first days of acute infarction and 44.6% after hospitalization, and stated that "the data of these cases provide no evidence that hematocrit values preceding the infarction were higher than at the time of admission." Since they did not report the standard deviation, we cannot calculate the significance of the difference between the means, but we cannot confirm their statement because the mean HCT decreased from the pre-infarction period until the hospitalization, which may or may not be highly significant.

Burch and DePasquale[1] presented a control group with a mean age identical with that of the infarction group. Thus the age factor was eliminated. In the control group they included hospitalized patients with psychiatric and dermatological conditions. We do not know how many such patients were tested, but it is possible that their blood was taken always or occasionally in the recumbent position or after meals, which may explain the low mean HCT of this group. It is true that they tested patients with acute myocardial infarction also at bed rest; however, in 92% of this group several of the HCT readings were made prior to the acute infarction and the average of all these readings was taken. Consequently, the mean HCT of their "infarction" group reflects more closely the pre-infarction HCT of their patients than does that presented by Conley *et al.*[3]

A comparison of our data with the previous reports (Table II) shows that the mean HCT of our controls is lower than that described by Conley *et al.*[3] and higher than that reported by Burch and DePasquale.[1] This can be explained by the difference of ages and posture of the controls in the three studies. Our coronary group exhibited the highest HCT values recorded in these reports, which is due to the fact that our patients were ambulatory, did not have any acute illness at the time of the test and were seven or eight years younger than those referred to in the two other reports. Furthermore, all of our tests were performed on patients under "standard basal" condition, whereas the other studies did not take these factors into consideration.

TABLE II.—COMPARISON OF THE DATA FROM BURCH, CONLEY AND IN PRESENT STUDY

Group	Posture*	No.	Age Mean ±SD (yr.)	Age Range	Hematocrit % mean ±SD
Burch's controls	?Ambulatory ?Bed rest	100	59.0	30-90	44.7 ±3.5
Conley's controls	Ambulatory	915	27.0	20-72	47.3 ±2.7
Our controls	"Standard basal"	68	50.8 ±7.3	35-62	46.8 ±3.2
Burch's infarction group	Bed rest and ambulatory	100	59.0	30-90	48.6 ±4.1
Conley's infarction group	Bed rest	200	58.0	29-90	46.0 ±5.4
Our coronary group	"Standard basal"	66	51.5 ±6.7	37-64	49.1 ±2.4

*For at least 30 min. before blood test.

Our study demonstrates that the HCT values of male patients with chronic coronary heart disease are significantly higher than those of apparently healthy males of the same age if the tests are performed on patients under "standard basal" conditions. This is not to imply that this factor alone plays a significant role in the development of acute symptoms of coronary heart disease or the vascular disease itself. We demonstrated that the viscosity of plasma of these patients is higher than that of healthy subjects.[10] The combination of high HCT and high plasma viscosity creates a significantly higher whole blood viscosity than that observed in healthy controls. This hemodynamic factor may be responsible for the development of clinical symptoms of coronary heart disease and possibly of basic vascular disease itself.

SUMMARY

Male patients with chronic coronary heart disease were found to have significantly higher hematocrit values than healthy males of the same age. This difference can be readily observed if the tests are performed under "standard basal" conditions.

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