CHEMICAL CHANGES IN THE BLOOD AND URINE IN PROGRESSIVE MUSCULAR DYSTROPHY, PRO- GRESSIVE MUSCULAR ATROPHY AND MYASTHENIA GRAVIS*

F. H. McCrudden, M.D., AND C. S. Sargent, S.B.
BOSTON

In May, 1916, we¹ reported the following findings in a case of progressive muscular dystrophy: (1) low blood sugar; (2) low cholesterolin content of the blood; (3) creatinuria; (4) a rise in the sugar content of the blood accompanied by a corresponding increase in muscular strength following treatment.

We now submit further data² regarding the first patient, and figures for the glucose and cholesterolin content of the blood and the creatin content of the urine in other cases of progressive muscular dystrophy, in progressive muscular atrophy, in myasthenia gravis, and — as controls — in conditions not accompanied by myasthenia of any form.³

PERCENTAGE GLUCOSE IN THE BLOOD

Progressive Muscular Dystrophy:		Conditions Accompanied by Nephritis:	
(1) 0.064	(2) 0.068	(29) 0.123	(30) 0.123
(3) 0.080		(31) 0.133	(32) 0.146
Myasthenia Gravis:		(33) 0.159	(34) 0.204
(4) 0.0818	(5) 0.095	Miscellaneous Conditions:	
Progressive Muscular Atrophy:		(35) Hypertension	0.120
(6) 0.111	(7) 0.129	(36) Multiple sclerosis..	0.110
Chronic Arthritis:		(37) Hypotension	0.144†
(8) 0.086	(9) 0.088	(38) Tumor of the cord.	0.140
(10) 0.090	(11) 0.098	(39) Psoriasis	0.090
(12) 0.101	(13) 0.103	(40) Tuberculosis of the	
(14) 0.104	(15) 0.106	spine	0.103
(16) 0.109	(17) 0.115	(41) Neoplasm	0.118
(18) 0.118	(19) 0.121	(42) Pernicious vomiting	0.094
(20) 0.124	(21) 0.128	Normal:	
(22) 0.131	(23) 0.166	(43) 0.115	(44) 0.129
Chronic Endocarditis:		Chronic Arthritis with Rapid Mus-	
(24) 0.103	(25) 0.105	cular Wasting:‡	
(26) 0.107	(27) 0.110	(45) 0.119	(46) 0.120
(28) 0.127			

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* From the Robert B. Brigham Hospital.

† In view of the fact that the epinephrin content of the blood is high in cases of hypotension (Bedford, E., and Jackson, H.: The Epinephrin Content of the Blood in Conditions of Low Blood Pressure and "Shock," Proc. Soc. Exper. Med. and Biol., 1916, **13**, 85), this low blood sugar, nearly high enough to give rise to glycosuria, is to be noted.

‡ These are the same two cases reported in the earlier paper in which myasthenia developed as the result of marked muscular wasting secondary to rapidly progressing chronic arthritis.

BLOOD SUGAR

The blood sugar in these cases (nephritis, progressive muscular dystrophy and myasthenia gravis excepted) falls between 0.09 and 0.13 per cent.⁶ Since but few of these patients were in good health, the figures are not offered as normal standards; but other investigators have found approximately the same range of values in normal cases.⁷

Glucose content of the blood. Each small circle indicates glucose content of the blood in one case. Values for the same kind of disease are connected together with a line. Abbreviations P. M. D. = progressive muscular dystrophy; P. M. A. = progressive muscular atrophy; M. G. = myasthenia gravis; Chr. End. = chronic endocarditis; M. W. = cases of chronic arthritis with muscular wasting.

In the three cases of progressive muscular dystrophy the blood sugar is below the normal. In the two cases of myasthenia gravis the blood sugar is a little below the normal. In the two cases of progressive muscular atrophy blood sugar is normal.

CREATINURIA

Large quantities of creatin were present⁸ in the urine of the two patients with progressive muscular dystrophy. The urine of the third (an outpatient) was not examined. In Patient 1 the creatin excretion ran from 0.283 to 0.624 gm. per day, the average for seven days being 0.465 gm. In Patient 2, creatin ran from 0.356 to 0.608 gm., the average for eleven days being 0.503 gm. per day.

Of the two patients with progressive muscular atrophy, one showed 0.198 gm. in a day's urine, the other an average of 0.130 gm. per day.

In one of the patients with myasthenia gravis (Patient 5) creatin was absent from the urine (the urine was examined every day for ten days). In the other (an outpatient) the urine was not examined.

CHOLESTERIN

The cholesterin of the blood was low in all three cases of progressive muscular dystrophy. The normal amount by the same method of analysis runs from 1.60 to 2.40 mg. per gram of blood, and averages about 1.90. The percentage in these cases was:

Case 1, 0.50 to 1.44; Case 2, 1.18; Case 3, 1.40.

Blood cholesterin was not low in the patients with progressive muscular atrophy or in those with myasthenia gravis.

BLOOD SUGAR AND IMPROVEMENT IN STRENGTH

In only one of the patients were we able to compare for long the glucose and cholesterin content of the blood with the improvement in muscular strength under treatment. The blood sugar was as follows:

	Blood Sugar Percentage
Oct. 27, 1915.....	0.068
Nov. 5, 1915.....	0.060
Treatment Begun	
Nov. 16, 1915.....	0.074
Nov. 23, 1915.....	0.091
Nov. 30, 1915.....	0.081
Feb. 21, 1916.....	0.095
June 20, 1916.....	0.110
March 7, 1917.....	0.103

From the time treatment began the glucose showed an almost continuous rise. There was a corresponding continuous gain in strength, and at the time of the last examination the patient had nearly completely regained his strength. Under treatment for ten days the blood sugar of Patient 2 rose from 0.068 to 0.094 per cent. The patient then moved to a distant city and the course of the disease could not be followed.

ACIDOSIS

On account of the relationship of changes in the acid-base equilibrium to disturbances of the metabolism of sugar and creatin, the ammonia excretion in the urine was determined from day to day; but in none of our cases did it ever rise higher than 0.43 gm. per day—a figure that is well within the normal limits.

SUMMARY

In three cases of progressive muscular dystrophy were found: (1) muscular weakness, (2) hypoglycemia, (3) hypocholesterinemia, (4) creatinuria, (5) normal ammonia excretion, (6) a rise of blood sugar in the treated patients with a parallel increase in strength.

A comparison of the findings in three somewhat similar clinical conditions showed the following:

	Blood Sugar	Creatinuria
Progressive muscular dystrophy....	Low	Present
Progressive muscular atrophy.....	Normal	Present
Myasthenia gravis.....	Low	Absent

REFERENCES

1. McCrudden, F., and Sargent, C.: Hypoglycemia and Progressive Muscular Dystrophy, *THE ARCHIVES INT. MED.*, 1916, **17**, 465.
2. The technical details of the methods are described in our previous paper.
3. Since Dr. George Clymer, neurologist to the Robert B. Brigham Hospital, who searched the community and found these myasthenic cases, is now in the national service abroad, we see no probability of obtaining any more cases in the near future.
6. Blood sugar appears to remain fairly constant from day to day in any one individual: (32) January 3: 0.145 per cent.; July 5: 0.147 per cent.; (33) August 20: 0.159 per cent.; August 23: 0.159 per cent.; (42) December 17: 0.095 per cent.; December 30: 0.092 per cent.
7. It is to be regretted that the very useful normal figures recently reported by Gettler and Baker (*Jour. Biol. Chem.*, 1916, **25**, 211) were not controlled by duplicate analyses. Some of the extreme figures would then be less open to suspicion.
8. On a meat-free diet.