

THE REACTION OF SALOMON AND SAXL AS A DIAGNOSTIC TEST FOR CARCINOMA *

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Salomon and Saxl¹ have described a reaction in the urine which they consider to be characteristic of carcinoma. The reaction depends on the supposed presence in the urine of such patients of a sulphur-containing substance, which does not yield inorganic sulphate on treatment with dilute hydrochloric acid, but which, on subsequent treatment with hydrogen peroxid, is oxidized, with liberation of inorganic sulphate. They report positive results in 70 per cent. of cases of carcinoma. They state that the reaction is frequently positive in the urine of pregnant women and in the urine of patients with cirrhosis or abscess of the liver. In a second paper² they describe the following modification of their previous method:

One hundred c.c. of the albumin-free urine are measured into a 400 to 500 c.c. beaker, 10 c.c. of hydrochloric acid (spec. grav. 1.12) are added, the contents of the beaker are heated to boiling on an asbestos-center wire-gauze and 200 c.c. of boiling water are added at once. If the specific gravity of the urine is less than 1.020, 10 c.c., if greater than 1.020, 15 c.c. of 10 per cent. barium chlorid solution are added, drop by drop. The beaker is covered with a watch-glass and kept on a boiling water-bath for six hours. After standing twenty-four hours the liquid is filtered through a double filter and refiltered into a 500 c.c. Erlenmeyer flask. Three c.c. of perhydrol (Merck's 30 per cent H_2O_2) are added and the mixture is boiled for fifteen minutes. It is then transferred to a conical vessel and allowed to stand. The deposit of a perceptible precipitate within a few hours is regarded as a positive reaction.

According to Kaldeck,³ the reaction is not characteristic of carcinoma. He found that in the urines of nine patients with carcinoma, the reaction was positive in four, negative in four and doubtful in one. Of thirty-seven urines from other patients, eight gave positive results. Of the eight, five were from tuberculous patients, out of a total of nine examined. Pribram⁴ tested the urine of forty patients with carcinoma, five with sarcoma and forty who were free from malignant growths. Of the cancer urines, 60 per cent. gave positive reactions; of the others, only 35 per cent. He recommended the use of potassium permanganate as the

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* From the Chemical Laboratory of the Montefiore Home.

1. Salomon and Saxl: *Wien. klin. Wehnschr.*, 1911, xiii, 449.

2. Salomon and Saxl: *Deutsch. med. Wehnschr.*, 1912, xxxviii, 53.

3. Kaldeck: *Wien. med. Wehnschr.*, 1911, lxi, 1652.

4. Pribram: *Wien. klin. Wehnschr.*, 1911, xxiv, 1235.

oxidizing agent because it yielded a clearer liquid in which the precipitate could more readily be detected. Murachi⁵ weighed the barium sulphate precipitated in the test. He had urines from four patients with carcinoma and from sixteen other patients. In the former, the amount of barium sulphate obtained varied from 0.0080 to 0.0176 gm., averaging 0.0120 gm., in 100 c.c. of urine, or 0.0779 in the twenty-four-hour quantity, or 2.43 per cent. of the total sulphur. The other urines yielded from 0.0020 to 0.0080 gm., averaging 0.00485 gm. in 100 c.c., or 0.0560 gm. in the twenty-four-hour quantity, or 1 per cent. of the total sulphur. Very good results have been reported by Petersen.⁶ Only three out of fifty-five urine patients without carcinoma gave the reaction, whereas

TABLE 1.—NORMAL URINES

Name	BaSO ₄ from 100 c.c.		BaSO ₄ from Twenty-Four Hour Quantity		Ratio of Sulphur Precipitated in the Test to Total Sulphur, Per Cent.
	In the Test, mg.	Total Sulphur, gm.	In the Test, gm.	Total Sulphur, gm.	
I. G. ...	11.0	936	.....	.....	1.18
I. G. ...	7.8	811	.....	.....	0.96
I. G. ...	9.8	798	0.127	10.350	1.23
W. R. ...	5.3	333	.....	.....	1.60
B. G. ...	15.0	1001	0.078	5.205	1.50
B. G. ...	16.7	1107	0.149	9.982	1.50
J. B. ...	6.8	666	0.105	10.320	1.02
P. K. ...	6.5	692	0.091	9.688	0.94
M. W. ...	6.7	670	0.061	6.131	1.00

of nineteen urines from seventeen cases of carcinoma only two failed to do so. The patients from whom these two urines were obtained were cachectic, and Petersen believes that this may be responsible for the negative results in these cases. He does not attempt to explain how cachexia operates to cause the disappearance of a reaction supposed to be characteristic of carcinoma.

There seems to be a general agreement among these writers that the reaction, although not characteristic of carcinoma, is much more frequent in the urines of patients with carcinoma than in other urines. It should be remembered, however, that Murachi was the only one who regularly weighed the barium sulphate obtained, and that he had only four cases of carcinoma. This is very important, for a precipitate is obtained with any urine, and normal and carcinoma urines are said to differ only

5. Murachi: *Biochem. Ztschr.*, 1912, xli, 139.

6. Petersen: *Deutsch. med. Wchnschr.*, 1912, xxxviii, 1536.

in the amount of precipitate obtained. It is very difficult, indeed, to compare the amounts of barium sulphate produced under the conditions of the test without actually weighing them, for the absorbed organic material varies greatly in amount and character, but is always considerable.

At the request of Dr. S. Wachsmann, medical director of this institution, I tried this reaction in a number of urines. It soon became evident that the differences that might exist between urines from patients with and without carcinoma were too slight to be detected by simple inspection. Thereafter the precipitates obtained were weighed. The

TABLE 2.—VARIOUS PATHOLOGICAL URINES .

Name	Diagnosis	BaSO ₄ from c.c		BaSO ₄ from Twenty-Four Hour Quantity		Ratio of Sulphur Precipitated in the Test to Total Sulphur, Per Cent.
		In the Test, mg.	Total Sulphur, mg.	In the Test, gm.	Total Sulphur, gm.	
H. B.	Nephritis, myocarditis	3.0	292	0.051	4.964	1.03
A. S.	Muscular atrophy....	5.5	693	0.039	4.751	0.80
W.	Levulosuria...	4.2	388	0.067	6.208	1.09
L. M.	Cirrhosis of liver	12.6	840	0.064	4.284	1.50
E. S.	Myelogenous leukemia...	7.4	321	0.109	4.719	2.31
M. R.	Diabetes.....	3.5	342	0.034	3.320	1.01
S.	Pulmonary tuberculosis.	3.5	438	0.049	6.139	0.80
	Pneumonia.	9.2	770	0.149	12.470	1.20

directions of Salomon and Saxl were carefully followed, the only deviations being the following:

1. A single thickness of Schleicher and Schull's No. 589 blue ribbon filter paper was used to filter the liquid after heating with acid and standing a day. The filtrates were clear.

2. After treatment with perhydrol the mixture was allowed to stand overnight and was then filtered through a Gooch filter. The precipitate and filter were washed thoroughly, ignited and weighed.

Total sulphur was determined by Benedict's method.⁷ Most of the determinations, both of the barium sulphate precipitated by the procedure of Salomon and Saxl and of the barium sulphate obtained from the total sulphur were made in duplicate.

7. Benedict: Jour. Biol. Chem., 1909, vi, 363.

The figures given in the accompanying tables require little comment. The amount of barium sulphate precipitated in the test from normal and pathological urines varies greatly. The highest value was obtained in a normal urine and the lowest in a urine from a patient with a very extensive carcinoma, primary in an ovary. There is apparently no relation between the amount of barium sulphate precipitated in this test and the presence or absence of carcinoma.

TABLE 3.—URINES FROM CASES OF MALIGNANT NEOPLASMS

Name	Diagnosis		BaSO ₄ from 100 c.c.		BaSO ₄ from Twenty-Four Hour Quantity		Ratio of Sulphur Precipitated in the Test to Total Sulphur, Per Cent.
	Carcinoma of	Established at	In the Test, mg.	Total Sulphur, mg.	In the Test, gm.	Total Sulphur gm.	
S. B.	Stomach	Operation....	4.4	260	0.055	3.221	1.69
S. B.	Stomach	Operation....	3.4	182	0.049	2.621	1.87
R. R.	Ovaries	Autopsy.....	0.7	182	0.011	2.957	0.38
Sol.	Stomach	Operation....	10.0	607	0.042	2.549	1.64
G. P.	Ovaries	Operation....	3.5	417	0.041	4.800	0.86
W. F.	Larynx	Operation....	7.0	591	.....	.....	1.18
S. R.	Stomach and colon	Clinical examination	11.2	710	.....	.....	1.58
Spiv.	Peritoneal cavity	Operation....	16.5	678	0.201	8.272	2.43
Leit.	Breast	Operation....	9.8	611	0.073	4.591	1.59
S. H.	Esophagus ...	Autopsy.....	7.1	361	0.069	3.500	1.94
I. G.	Mastoid	Operation....	9.1	760	0.066	5.470	1.20
E. G.	Larynx	Operation....	6.7	650	0.088	7.540	1.03
L. P.	Sarcoma of Lungs	Clinical examination	5.8	489	0.037	3.130	1.19
F. R.	Hip	Clinical examination	9.6	753	.....	.....	1.28
H. B.	Peritoneal cavity	Operation....	6.5	636	0.066	6.420	1.02
M. A.	Thigh	X-Ray examination	9.2	297	0.078	2.520	3.10

It is true that most of the carcinoma patients were cachectic. It may be urged that this explains the discrepancy between the results here reported and those obtained by others, but this is not probable. Several urines were obtained from non-cachectic carcinoma patients. The amounts of barium sulphate obtained from these urines were not greater than those obtained from many of the normal urines. It would also be rather remarkable that the writers mentioned had obtained urines from patients with carcinoma, only comparatively few of whom were cachectic. Moreover, the value of a proposed test for carcinoma which is negative

in cachexia, one of the most characteristic symptoms of the disease, is, on this ground alone, open to serious question.

SUMMARY

No differences were found to exist between the urines of patients with carcinoma and other diseases and normal individuals, in the amount of barium sulphate, either absolute or relative to the total sulphur, precipitated by the procedure of Salomon and Saxl. It is therefore concluded that the test is of no value in the diagnosis of carcinoma.