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URINE ALBUMIN TEST

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It is the object of my invention to provide a simple, rapid, and convenient test for albumin in urine; and one that can readily be made by a physician in a sick-room without elaborate equipment, without heat, and without the need of other liquid than the urine itself and conveniently some water, which may be ordinary tap water.

The ordinary procedure for testing for albumin in urine is one that requires technical knowledge, skill, and experience; and that also requires the use both of heat and of a liquid acid. While this can be done in hospitals, even there it involves some technical difficulties, and a very considerable chance of error due to the personal equation of the technician; and it is practically impossible for the general physician to use in the ordinary home sick-room.

My invention permits an accurate test to be made readily even by unskilled persons, with no other apparatus than a test tube, no heat, and the use of no liquid acid, and with little or no chance of material error from the observer's personal equation. A physician can make the test in the sick-room within a minute, and know at once from his own observation what a patient's condition is with respect to albumin in the urine.

Such immediate knowledge is desirable for the physician in many pathological conditions, in order that he may from the beginning conduct his treatment accordingly. Albumin is likely to occur in many cardiac conditions, in cases of high blood pressure and arteriosclerosis, in nephritis, in cases of kidney stones, in rheumatic fever, in various contagious fevers such for instance as scarlet fever, and in diabetes, to mention but a few; and sometimes the condition may be such that it is not safe to start treatment without a knowledge of the urine-albumin situation, and also not safe either to move the patient (as in cardiac conditions) or to wait to send a urine sample to a hospital laboratory for test. My test meets these difficulties.

In accordance with my invention, I proceed generally as follows:

I take a fixed quantity of the urine to be tested, say 4 cc., desirably in a test tube bearing a mark indicating that amount. For reasons which will appear, I then desirably dilute the urine to twice its volume, with ordinary tap water if no other is available, as by adding 4 cc. of water if the original amount of urine was 4 cc.; although this dilution step is not one that is essential to my invention. Then I add to the urine, which has preferably been diluted as stated, "sodium hexametaphosphate," an acidulating agent which may be carried and even added in solid form, and desirably a non-albuminous cold-water-soluble protective colloid, such as dextrin—desirably with all of them in solid form, although any of them may be added in solution form. The acidulating

agent is most conveniently glutamic acid hydrochloride, or (less desirably) oxalic acid; and it is added, conveniently in solid form but permissibly in solution, in sufficient amount to acidify the diluted urine to a pH at least as low as pH 4.5. The sodium hexametaphosphate, which is available on the market under the trade-mark 'Calgon', reacts with the albumin present in the dilute acidulated urine to produce a turbidity, and eventually a flocculent precipitate, dependent in amount on the quantity of the albumin present. The turbidity produced indicates the amount of albumin, and is readily and accurately determined by comparison with a turbidity chart which shows different turbidities within the obtainable range. The dextrin or other non-albuminous protective colloid, which should be added at least as early as is one of the other two reagents, retards the settling out of the precipitate, and thereby lengthens the time during which the turbidity persists as such; as is desirable for the comparison with the turbidity chart. The dextrin (or other non-albuminous cold-water-soluble protective colloid) may be omitted, but it is then necessary to make the comparison of turbidity with the turbidity chart very promptly in order to avoid error by reason of settling of the precipitate to the bottom of the test tube; so that by using the dextrin or other non-albuminous protective colloid, and thus retarding the precipitation so that there is no material change in the turbidity for a period of several minutes, there is less danger of inaccuracy in comparison.

The reagents used—sodium hexametaphosphate, glutamic acid hydrochloride, and dextrin—may all be dry powders; and in that form do not react with one another over long periods of time. As a result, they may be put up as a mixture in unitary reaction units, such as capsules, each of which contains the desired amount of the three reagents for a test. The sodium hexametaphosphate and the glutamic acid hydrochloride should be about equal in amount, and the dextrin about one-fiftieth ($\frac{1}{50}$) of the sum of the other two. If the test is made on 4 cc. of urine, diluted to 8 cc., there should be at least about 30 mg. of each of the first two reagents if a full-range test is to be made; and I have found desirable amounts in each capsule to be as follows:

	Milligram
Sodium hexametaphosphate.....	50
Glutamic acid hydrochloride.....	50
Dextrin	2

A number of these capsules may be put into a small bottle, and that bottle put in a small case with a test tube which is marked at the 4 cc. and 8 cc. levels. That equipment, together with a turbidity chart, which may be printed on the in-

side cover of the case, constitutes the entire equipment needed for the test.

To make the test, the physician merely needs to put enough of the patient's urine in the test tube to reach the 4 cc. level, add tap water to the 8 cc. level, empty the contents of one capsule into the test tube, shake, and compare the turbidity which is immediately produced with the turbidity chart to determine what the albumin content is. The chart may be graduated in either or both of two ways, desirably both. That is, it may show the commonly accepted terms as used with present tests for albumin, which are: slight trace, trace, 1+, 2+, 3+, and 4+; but the indications of these on the turbidity chart may also bear the corresponding markings in milligrams of albumin per 100 cc. of urine, in which case the indications just given correspond respectively to approximately 8-10 mg., 12-14 mg., 18-20 mg., 30-35 mg., 45-50 mg., and greater than 50 mg. If desired, the turbidity chart may contain intermediate indications, of any desired number; but those given are usually sufficient for a physician's purposes, for fair approximations of any desired intermediate values in milligrams per 100 cc. may readily be determined with sufficient accuracy by simple interpolation.

The dilution of the urine before adding the reaction unit is desirable for several reasons. First, such dilution prevents the precipitation, or causes the re-solution, of salts such as calcium or magnesium carbonates, which may be present in the urine. Second, the dilution spreads out the turbidity over a larger range, and facilitates comparison with the turbidity chart; and the turbidity chart I prefer is graduated on the basis of the diluted urine, although one can be used which is graduated on the basis of undiluted urine. Third, by diluting the urine, and using the quantities of reagents indicated, the turbidity produced corresponds so closely to the turbidity produced in the test now commonly made with heat and acetic acid that a technician experienced in that test can read the turbidities produced by my test with substantial accuracy even without making actual comparisons with the turbidity chart.

I claim as my invention:

1. A process for testing for albumin in urine, which consists in diluting a fixed quantity of the urine, and adding to the diluted urine sodium hexametaphosphate and an acidulating agent of the class consisting of glutamic acid hydrochloride and oxalic acid, to produce a turbidity which by comparison with a turbidity chart indicates the quantity of albumin in the urine.

2. A process for testing for albumin in urine,

which consists in adding to a fixed quantity of urine sodium hexametaphosphate and an acidulating agent of the class consisting of glutamic acid hydrochloride and oxalic acid, to produce a turbidity which by comparison with a turbidity chart indicates the quantity of albumin in the urine.

3. A process for testing for albumin in urine as set forth in claim 2, in which a non-albuminous cold-water-soluble protective colloid is added to the urine at least as early as is one of the other two reagents.

4. A process for testing for albumin in urine, which consists in diluting to a fixed volume a fixed smaller volume of urine, and adding to the diluted urine a definite quantity of a fixed-proportion mixture containing sodium hexametaphosphate and glutamic acid hydrochloride and dextrin, to produce a turbidity which by comparison with a turbidity chart indicates the quantity of albumin in the urine.

5. A process for testing for albumin in urine, which consists in adding to a fixed quantity of urine, a definite quantity of a fixed-proportion mixture containing sodium hexametaphosphate and glutamic acid by hydrochloride, to produce a turbidity which by comparison with a turbidity chart indicates the quantity of albumin in the urine.

6. A protein-precipitant reaction unit, which reaction unit contains in solid form sodium hexametaphosphate and an acidulating agent of the class consisting of glutamic acid hydrochloride and oxalic acid.

7. A protein-precipitant reaction unit, which reaction unit contains in solid form sodium hexametaphosphate and an acidulating agent and a non-albuminous cold-water-soluble protective colloid, said acidulating agent being a member of the class consisting of glutamic acid hydrochloride and oxalic acid.

8. A protein-precipitant reaction unit, which reaction unit contains in solid form sodium hexametaphosphate and glutamic acid hydrochloride.

9. A protein-precipitant reaction unit, which reaction unit contains in solid form sodium hexametaphosphate and glutamic acid hydrochloride and dextrin.

10. A protein-precipitant reaction unit, which reaction unit contains sodium hexametaphosphate and oxalic acid.

11. A protein-precipitant reaction unit, which reaction unit contains a definite amount of a fixed-proportion mixture of sodium hexametaphosphate and oxalic acid.

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