

Case in which a large quantity of nitrate of potash was taken medicinally : elimination of this salt by the urine. With remarks / by Dr. Wilks and Alfred S. Taylor.

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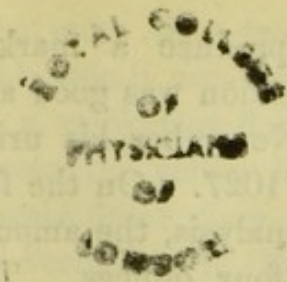
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CASE

IN WHICH

A LARGE QUANTITY OF NITRATE OF POTASH WAS TAKEN MEDICINALLY.

ELIMINATION OF THIS SALT BY THE URINE.

WITH REMARKS.

BY DR. WILKS AND DR. ALFRED S. TAYLOR.

JOHN D—, æt. 34, was admitted, under Dr. Rees, on September 25th, 1862, for renal dropsy, and was subsequently transferred to Dr. Wilks's care. Nine months before admission, after taking cold, swelling of the legs appeared, and subsequently dropsy of other parts. He was ordered a saline mixture, with antimony and jalap powder. He continued this treatment until October 14th, when, being much better, he was ordered some Vinum Ferri. He was now walking about the ward; but there being some œdema of the leg remaining, Dr. Rees wished to try the effects of large doses of nitrate of potash as a diuretic. On October 28th he was ordered half a drachm of nitrate of potash, in mint water, three times a day. Very little effect was produced on the urine as to quantity, and therefore, on October 30th, the dose was increased to a drachm three times a day. After this he appeared to pass more water, but it was not regularly measured; he walked about the ward, and had resumed his ordinary healthy aspect, although some slight œdema of the ankles still remained, and the urine was still albuminous. On the 17th November the dose of nitrate of potash was increased to one drachm and a

half three times a day. This did not produce a marked effect on the system in any way; his digestion was good and his bowels were regular. On the 23rd November his urine was found still albuminous, and of sp. gr. 1027. On the following day (the 24th) it was collected for analysis, the amount passed in twenty-four hours being sixty-four ounces. The patient continued to take the nitrate of potash up to about the 26th December, when the steel mixture was resumed. He left the hospital in the following week.

Analysis.—The urine collected on the 24th November was of a somewhat deeper colour than usual, but otherwise presented nothing remarkable in its physical properties. Its sp. gr. was 1029. The solid contents amounted to 5·8 per cent. In the entire urine the chlorides and sulphates were more abundant than they are commonly found.

As the object was chiefly to determine the elimination of *potash*, twenty ounces of the urine were evaporated to dryness, and the residue incinerated. The residue left a white ash, weighing 178 grains, the greater part of which was dissolved by water, forming a strongly alkaline solution, which effervesced on the addition of acids (alkaline carbonate). The amount of potash contained in this soluble residue was found to be 43·87 grains. The proportion of this alkali contained in urine is liable to great variation; but according to a recent analysis of healthy urine of a sp. gr. of 1020, leaving a solid residue of 4·4 per cent., the proportion of potash in 1000 grains is 1·93 grains. (Miller.) Calculated for twenty ounces of the liquid, this would be equivalent to 17·83 grains, and thus in the above sample of urine there was apparently an increase of 26·04 grains. The increase may, however, be more correctly determined by comparing the proportion of potash to the fixed saline matter in normal urine. Here, again, we meet with differences according to age, sex, state of health, abstinence, &c. The normal urine, above referred to, of a sp. gr. of 1020, yielded by the evaporation and incineration of 1000 grains, 13·35 grains of fixed salts, the potash contained in these salts weighing 1·93 grain. In 178 grains of saline matter (from the sample analysed) there would, therefore, be 20·78 grains of potash, showing an increase of 23·09 grains over the normal average. Hence the quantity of potash

was more than twice as great as that found in ordinary urine. This alkali was readily detected by igniting the saline residue in a smokeless flame; and by the employment of an indigo screen the yellow light of sodium was entirely cut off, and the purple flame given by potassium was remarkably striking.

According to Berzelius, 1000 grains of normal urine yield 15.29 grains of fixed salts, of which sulphate of potash forms 3.71 grains. This is equivalent to two grains of potash. Hence, according to this authority, the potash in normal urine forms rather more than one seventh part of the weight of the fixed residue. This does not differ materially from the proportion in the sample taken as a standard of comparison, although the total quantity of fixed salts is greater. The proportion of potash in normal urine may be taken as ranging from one seventh to one eighth part of the weight of the fixed salts. In the sample submitted to analysis it amounted to about one fourth of the weight. The weight of the fixed salts eliminated by the urine in twenty-four hours has been made a subject of investigation by Scherer. According to this chemist, the weights are as follows: in a child, 169.42 grains; in a boy, 159.84 grains; in a young man, 364.64 grains; and in a man in a state of abstinence, 55.8 grains. The proportion of fixed salts contained in the urine submitted to examination, was considerably greater than in any of the instances assigned by Scherer. Thus, as 178 grains were found in twenty ounces of this urine, while four pounds, or sixty-four ounces, had been passed by the patient in the preceding twenty-four hours, the amount of fixed saline matter eliminated during this period would be 569.6 grains. Results of this kind do not admit of any just comparison, unless the amount of urine passed within the twenty-four hours is specified. All other circumstances being equal, the difference would, of course, be great in comparing normal urine with that of a person who was taking daily a large quantity of any neutral salt. The average quantity of urine daily secreted by a healthy adult was estimated by the late Dr. Prout at from thirty to forty ounces. In eighteen cases examined by Dr. Routh the average amounted to thirty-five ounces. Dr. Golding Bird considered that a quantity varying from twenty to fifty ounces was consistent with health, and that less was excreted during summer

than during winter, obviously from an increase in the vicarious functions of the skin during warm weather. M. Becquerel considers that in France the healthy daily average is forty-three ounces in men, and forty-seven ounces in women. The national habit of drinking freely, acid wines having diuretic properties, may account for the difference.

At the period at which this sample of urine was taken the patient passed, in one day, sixty-four ounces, or one third more than the average. This increase was, no doubt, due to the large quantity of nitre which he was then taking; it would satisfactorily account for the great difference in the relative proportion of fixed salts in the urine.

It appears to be conceded by all authorities that the alkali potash is ordinarily eliminated in healthy urine in the state of sulphate. This rule is, of course, interfered with when special salts of the alkali, such as the iodides and bromides, are taken medicinally. One of the objects of the analysis in the case of this patient was to determine whether, in this sample of urine, the potash was wholly or in part eliminated as it was received, *i. e.* in combination with nitric acid, as nitrate. Between October 28th and December 26th, 1862, the patient, a man *æt.* 34, took, in divided doses, one pound twelve ounces and six drachms of nitrate of potash; and as no toxicological effects had ensued, the question was, how had this enormous quantity of a neutral salt been discharged from the system. Twenty ounces of the same sample were evaporated to an extract, and this was treated with successive quantities of alcohol and water, in order to separate, as far as possible, the organic and saline matters. The dark-coloured, aqueous solution obtained, amounting to about four and a half ounces, contained sufficient nitrate of potash to give deflagrating properties to paper which was dipped in it and dried, in spite of the presence of a large quantity of chloride of sodium. Crystals of nitrate of potash were also obtained by spontaneous evaporation. These were identified by their prismatic character under the microscope, as well as by their power of dissolving leaf gold, when mixed and heated with pure hydrochloric acid. That gold was dissolved was proved, not only by its disappearance, but by adding a solution of chloride of tin to the liquid when the purple precipitate of Cassius was

thrown down. A portion of the liquid was completely decolorized by pure animal charcoal, and from this solution more perfect crystals of nitre were obtained. They were, however, intermixed with a large number of cubic crystals of alkaline chlorides, and with feathery crystals of phosphate of soda. The only salts found in the liquid were the chlorides, sulphates, and phosphates, and the only bases were potash and soda.

Assuming that the normal amount of potash was eliminated in this urine as sulphate, the additional quantity of the alkali found in this sample (23.09 grains) would represent 49.61 grains of nitrate of potash in twenty ounces; and this would be equivalent to 2.48 grains of nitre in each ounce of urine. As sixty-four ounces of urine were passed in twenty-four hours, this would be equivalent to 158.7 grains of nitrate of potash carried out by the urine daily, while the patient was taking, within that period, four drachms and a half or 270 grains of the salt in three doses.

As each ounce of urine contained about eight grains of fixed salts, and the calculated amount of nitrate of potash was 2.48 grains, this would lead to the inference that the nitre eliminated by this liquid amounted to from one third to one fourth of the fixed salts. Judging by a microscopical examination of the crystalline residue, I am of opinion that the crystals of nitre did not form more than from one sixth to one eighth part of the crystalline mass. Hence it follows that only one half of the nitre assumed to be present was eliminated as such by the urine. As the sulphates and chlorides were in larger proportion than usual, it may be a question whether some portion of the potash may not have been carried off with sulphuric acid or chlorine. It is not necessary, however, to resort to this hypothesis in order to account for the small proportion of nitre in the urine, or for the fact that while the patient was taking daily 270 grains of the salt, not more than 158.7 grains were eliminated by this liquid. There is another channel by which large quantities of neutral salts are carried out of the body, namely, the intestines. It is nearly twenty years since M. de Kramer, of Milan, first announced, as the results of his experiments with this salt, that he had detected nitrate of potash in the blood, urine, and fæces of animals to which this mineral compound had been administered. The

reader will find a full account of these experiments, with the methods of analysis adopted, in the 'Annales d'Hygiene Publique et de Médecine Légale' for 1843, vol. i, page 417. In reference to the medicinal action of nitre as a diuretic, this case appears to show that an enormous quantity of the salt given daily in safe doses, will fail to produce any marked effect upon the kidneys. The urine and intestinal secretions become charged with the salt, which is speedily ejected from the system. When the dose has ceased to be medicinal, and the salt exerts an irritant or poisonous action, then a powerful effect on the kidneys may be witnessed. In a case reported by M. Cardon, a man swallowed, by mistake, in one dose, three ounces (1440 grains) of the nitrate of potash. Violent intestinal irritation with copious diuresis followed. The first quickly subsided, and was followed by a constant desire for food and drink, with a tendency to emaciation. The patient continued to pass from five to six pounds of urine every night. The urine was found to contain sugar. The presence of nitrate of potash in it is not noticed. These symptoms gradually disappeared ('Edinburgh Monthly Journal,' March, 1849, p. 71).

One remark on the toxicological bearing of this case. Nitrate of potash is, beyond doubt, an irritant poison. This has been proved by the experiments of Orfila and others, and the statement is confirmed by the cases which have been published in my work on Poisons (second edition, 1859, page 337). One ounce taken at a dose has destroyed the life of an adult in three hours. Other cases are related in which doses of from one ounce to an ounce and a half, have destroyed life in two and five hours respectively. The symptoms and appearances produced were those of an irritant poison in all these cases. The poisonous action of a substance of this nature is dependent on the dose taken at any one time, as well as on the frequent repetition of the dose. It does not appear that, in this case, my colleague, Dr. Wilks, gave at any one time a larger dose than one drachm and a half (ninety grains), and this only three times a day. There was, therefore, ample room for elimination, both by the bowels and urine; and no danger that such an amount of the salt would accumulate in the body as to produce symptoms of poisoning. When these

precautions, regarding the dose and frequency of administration are observed, almost any amount of an active poison, and, *à fortiori*, of a neutral salt like nitre, may be passed through the system, not only without danger to life, but sometimes with actual benefit in its medicinal operation. In a period of fifty-nine days this patient took a quantity of nitre amounting to twenty-eight fatal doses; and at no time more than a fatal dose (in divided portions) over a period of *two days*. The rapid passage of the salt out of the body accounts for the immunity of this patient from any toxicological effects. Had the quantity thus spread over two days been given in a single dose, there is no reason to suppose that this man, like others, would not have succumbed to its poisonous action.

I am indebted to my colleague, Dr. Wilks, for a fact connected with the medicinal use of arsenic, which will serve to illustrate the statement above made regarding the operation of poisonous agents. In treating a case of eczema in Guy's Hospital, he prescribed for the patient, a boy under his care, the twenty-fourth part of a grain of arsenic three times daily, making one eighth of a grain per diem. This was continued for seventy days, so that in ten weeks the boy had taken nearly nine grains of arsenic. As two grains of this substance have proved fatal to an adult, it follows that this boy, in the period stated, had taken sufficient arsenic to destroy four adults. Dr. Wilks sent to me the urine daily for examination, and arsenic was found in it. There was no doubt that elimination and absorption went on *pari passu*, and that while this mineral, in passing through the system, exerted a medicinal action, it did not so accumulate in the body as at any time to manifest the usual toxicological effects. When the arsenic was wholly withdrawn the proportion in the urine underwent a daily decrease, more and more of the urine being required in order to demonstrate its presence. It was found in this secretion up to the tenth day, when the patient, who imagined he was being made the subject of experiments, suddenly left the hospital, and could not be afterwards discovered.

protection, regarding the dose and frequency of administration
 are observed, almost any amount of an active poison will
 be fatal if a neutral salt like silver may be passed through the
 system, not only without danger to life, but sometimes with
 actual benefit in its medicinal operation. In a period of fifty-
 nine days this patient took a quantity of nine grammes of
 the (in diluted solution) over a period of two days. The result
 was perfectly fatal; and at no time more than a fatal
 quantity of the salt out of the body account for the intensity
 of this patient's case any far beyond the usual effects. Had the quantity
 that passed over two days been given in a single case, there
 is no reason to suppose that this man, his organs, would not
 have succumbed to its poisonous action.

I am indebted to my colleague, Mr. Williams, for a fact con-
 nected with the medicinal use of arsenic which will serve to
 illustrate the statement above made regarding the operation of
 poisons again. In treating a case of disease in which
 the arsenic was given for the patient, a day or two after
 making good use of it, the patient died. The arsenic was
 for several days, and in ten weeks the patient died. The
 arsenic was given in a dose of five grains of the arsenic
 have proved fatal to all that it follows that this dose in the
 period stated, and that arsenic is known to be very dan-
 gerous. Mr. Williams sent to the British Army for examination
 and arsenic was found in it. There was no doubt that arsenic
 iron and arsenic was found in the body, and that while this
 arsenic in passing through the system, exerted a medicinal
 action, it did not accumulate in the body at any time to
 manifest the usual toxic effects. When the arsenic was
 wholly withdrawn the arsenic in the urine underwent a
 daily decrease, more and more of the urine being required in
 order to eliminate the arsenic. It was found in the urine
 soon up to the point where the patient was discharged, he
 was being with the subject of experiment, who only left the
 hospital and could not be otherwise discharged.