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A Course of Lectures ON URINE, URINARY DEPOSITS, AND CALCULI.

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LECTURE XI.

IV.—THIRD CLASS OF URINARY DEPOSITS.

[Continued from p. 948.]

Oxalate of Lime. The next substance which is to be noticed is oxalate of lime, which was first shown to be a common urinary deposit by Dr. Golding Bird. It is seldom deposited in quantity sufficient to be recognised by the unaided eye, or to be subjected to chemical examination.

Octohedral Crystals of Oxalate of Lime. This salt crystallises in well defined octohedra, having one axis much shorter than the two others. The crystals vary much in size, and two or three forms have been described by authors. In the cases I have met with, the different appearances of the crystals were due to the position in which they were viewed, as I shall be able to prove to you very readily by this glass model. The flattened octohedron is obviously the most common appearance, because the crystal lies most easily on one of its faces. If, however, it be turned with one of the long axes directed towards the observer, while the other is held upright, the short axis will necessarily be transverse, and the crystal will appear as a long and very acute octohedron (a, Fig. 40). If now one of the lines formed by the meeting of two opposite faces be turned towards you, there will still be the appearance of an acute octohedron; but it will be less acute than before, and no transverse line in the centre can be made out. Upon keeping the same line towards the observer, and by carefully turning the crystal, so that the eye can see two opposite faces quite parallel to each other, the curious appearance represented in the diagram will be produced. (Illustrations, Plate xi, Fig. 1, a, b, c, d, e.)

Fig. 40.—Octohedra, dumb-bell, circular and oval crystals of oxalate of lime.

Crystals in all these positions, appearing as different forms, are commonly met with in the examination of urinary deposits. In Fig. 40 are represented octohedra in various positions, dumb-bells, and circular and oval crystals of oxalate of lime,

with two cells of vaginal epithelium, deposited from the urine of a patient suffering from a tense state of the skin of the wrists and arms, a condition which is sometimes termed "hide-bound."

Many observers have figured these crystals incorrectly. Dr. Golding Bird considered that they belonged to the cubic system. Dr. Prout, however, has given a figure of oxalate of lime which clearly shows that he was aware of the exact form of the crystal. Prismatic crystals of oxalate of lime occur in some plants, and they have been observed by Beneke in urine. I found that some preparations of ordinary oxalate of lime, which had been kept for some years in preservative fluid, underwent a change in form, and were at length entirely replaced by beautiful prisms. Oxalate of lime may be obtained in its usual octohedral form from its solution in hydrochloric acid; and Neubauer states that from a solution in phosphoric acid it may be obtained in a crystalline form by neutralising the acid by soda or potash.

Dr. Thudichum has carefully examined the form of crystals of oxalate of lime obtained in different ways, and he brings all the different forms he has observed under the following heads: Quadratic octohedron, crossed octohedra, quadratic octohedron and prism combined; crossed prisms; triple twins, with tropia; modifications of crossed octohedra; contortions and anomalies, including dumb-bells. He also shows, contrary to previous statements, that the salt actually possesses a polarising power, as should be the case if it belongs to the quadratic system. This is, however, difficult to demonstrate, and can be "only brought out fully by reflecting a ray of the sun through the crystal", which accounts for the fact having escaped observation. I had long ago examined crystals by the polariscope which had been mounted in Canada balsam, and had noticed that they were often slightly illuminated when the field was dark. Although I had figured the form of the crystals correctly, I must confess that I was too ready to agree with the statements made by others as to the system to which this crystal belonged; neither was I sufficiently acquainted with crystallography to discuss this question fully. In this matter Dr. Thudichum has corrected me; and, after a reexamination of the question, it is only right that I should state that the octohedra, mounted in Canada balsam, do polarise even with a good artificial light; and therefore no argument in favour of the dumb-bell crystals being composed of oxalurate, and not of oxalate of lime, can be based on the statement that the octohedra do not polarise.

Dumb-Bell Crystals of Oxalate of Lime. Oxalate of lime, however, occurs more rarely certainly, but still not uncommonly, in another very interesting form, which was first pointed out by Dr. Golding Bird. From their resemblance to dumb-bells, these bodies are known as the dumb-bell crystals of

Fig. 41.—Dumb-bells of oxalate of lime, of very regular form.

Fig. 42.—Small collection of dumb-bells, such as often forms the nucleus of a calculus.

oxalate of lime. Dr. Golding Bird thought that they were composed of oxalurate, and not of oxalate of lime; but the following points, in addition to what has just been stated, render this very improbable.

1. Octohedra, in all the cases I have observed, were deposited from the specimen of urine in which the dumb-bells

were found, and invariably precede and follow the appearance of the dumb-bell crystals.

2. Minute calculi are often composed of dumb-bells, as may be shown by microscopical examination; and these calculi have been proved by analysis to consist of oxalate of lime. (Fig. 42.)

The crystalline matter of the dumb-bell may be dissolved out by the prolonged action of acetic acid, when something very like a cell-wall remains. A certain quantity of organic matter exists in the interior of the apparent cell, and was no doubt in intimate union with the crystalline material in every part of the crystal. (*Illustrations*, Plate xi, Fig. 2, *t, u, v, w*.) Some persons have stated that these dumb-bell crystals were composed of uric acid—a mistake for which it is very difficult to account, since, in their optical characters and chemical properties, they widely differ. The uric acid dumb-bell is instantly dissolved by dilute potash, and, by the addition of excess of acetic acid, rhombic crystals will be thrown down; while the true dumb-bell is insoluble in a strong boiling solution of potash. Any observer, whose eye had been accustomed to the peculiar glistening appearance of the oxalate of lime dumb-bell, would not be likely to mistake it for a dumb-bell of uric acid.

Besides the dumb-bell, it is common to meet with a number of closely allied forms, among which may be mentioned circular and oval crystals. (*Illustrations*, Plate xi, Fig. 2, *a, b, c, d, e, f*.) In several of the cases which have fallen under my notice, the true and perfectly shaped dumb-bell was preceded by circular and oval crystals; and these also again appeared after true dumb-bells could no longer be detected in the urine. These crystals often disappear the day after multitudes have been found; and generally they are only noticed for a few consecutive days—a circumstance which may perhaps account for the comparatively few instances in which these crystals have been noticed.

Of the Formation of the Dumb-bell Crystals. It is well known that the octohedra of oxalate of lime are commonly deposited in the urine after it has left the organism; and if urine which contains very minute octohedra be allowed to stand for a few days, these may often be observed to increase in size, until at length they become very large crystals, while at the same time a number of new ones are developed. On the other hand, dumb-bell crystals are present in the urine when passed, and they do not increase in size or number if allowed to remain in the urine. These dumb-bell crystals seem to be formed in the renal tubes. I have found them entangled in casts in the urine of a cholera patient passed after eighteen hours complete suppression during the stage of collapse. The specimen of urine in which these casts were found was very acid, of a dark colour, and specific gravity 1024. The urine contained no albumen. The following report was made at the time of examination. Deposit very slight, consisting of transparent, smooth, and hyaloid casts, for the most part homogeneous, but in a very few of them a small quantity of granular matter was observed. In others, dumb-bell, oval and globular crystals of oxalate of lime were noticed. These dumb-bell crystals were seen only in the casts, but many octohedra were observed in the surrounding fluid. (*Illustrations*, Plate xxii, Fig. 1.)

I have seen many times a number of these dumb-bells impacted in the tubes of the kidney, especially in the pyramids. Indeed, if thin sections of this portion of human kidneys be made, these dumb-bell crystals will be observed not unfrequently. Often several may be seen in the wide portion of the tube, just before it opens upon the surface of the mamilla.

It is probable that where octohedral crystals are met with, connected with casts, they are deposited merely upon the surface or in the substance of the cast, after the urine has been allowed to stand for some time.

Of the Conditions under which Dumb-bell Crystals occur. I have met with a great many specimens of urine containing dumb-bells, but have been unable to associate the appearance of these crystals with any particular morbid condition. It may be interesting to refer to a few of these, which occurred in the hospital some years ago. During six months, I met with ten or eleven cases, in which these peculiar crystals were present, out of about four hundred cases in which the urinary deposit was examined; but I have not observed that the urine containing them possesses any characters by which we might be led to suspect their presence, before resorting to microscopical examination; and, from my own observations, it does not appear that the dumb-bells are connected with any peculiar form of disease, or with any particular diathesis. They occur usually mixed with the ordinary octohedra of the oxalate, but I have

found them alone; frequently they are found accompanied with urate of ammonia and crystals of uric acid, and often with both. Out of ten cases in which they were present, eight were men, and the remaining two were women, above the age of 21. Of these ten cases, nine occurred between the months of September and January, and one in April; but this may be accounted for by the fact, that during the winter I have always made a much greater number of microscopical examinations than during the summer months. It may prove interesting to give a list of the cases in which these dumb-bell crystals, or crystals allied to them in form, occurred. They were present in—

One case of chorea.

Two cases of cholera.

One case of chronic rheumatism.

One case of contraction of the skin of the neck and upper extremities, the condition to which the term "hide-bound" has been applied.

One case of boils, occurring in various parts of the body.

One case of paraplegia, depending upon diseased vertebrae.

One case of attempted poisoning by taking half an ounce of oxalic acid.

One case of eczema.

One case of epilepsy.

Out of these ten cases, in which the dumb-bell forms of crystal were present, it will be observed that only two instances occurred in which they were found in the urine of patients afflicted with a similar disorder, and it is somewhat curious that these should be cases of cholera. The other cases differ so entirely in nature from each other, that it appears difficult to suppose that this curious form of crystal is in any way dependent upon the nature of the malady, but we are rather led to conclude that these crystals arise from certain conditions in the secreting action of the kidney, unconnected with any particular disease. The dumb-bell crystals often occur in the urine of persons not suffering from any special disorder at all, who consider themselves in good health; but generally there is languor and loss of appetite, with uneasiness after eating, and the individual, without being able to give an account of any particular ailment, complains of not being quite well. Dumb-bells often occur in cases where little exercise is taken, with a full diet, and small quantity of fluids. The concentration of the fluids, and imperfect oxidation, are probably causes of the formation of these crystals in cases of cholera.

Sometimes several dumb-bells adhere together, forming an irregularly shaped mass, which gradually becomes smooth by the deposition of the same material in the interstices, until a small, nearly spherical or oval, mass is formed (Fig. 42). In other cases, it would appear that one or two crystals grow at the expense of the rest, and a perfectly uniform oval crystal, composed of course of numerous acicular crystals, radiating from a common centre, results. Thus the dumb-bell crystal becomes the nucleus of a small calculus, and it is easy to see how this may increase in size by the deposition of new matter externally—at first, while it remains in the straight portion of the uriniferous tube, or in that system of irregularly shaped cavities at the apex of the mamilla, formed by the convergence of several of the large tubes—then in the pelvis of the kidney or ureter, and, lastly, in the bladder itself.

Chemical Composition of the Dumb-bell Crystals. The chemical composition of these crystals has long been a matter of dispute among chemists, but it may now be regarded as nearly certain that they consist of oxalate of lime; for since it has been shown that the dumb-bell may gradually grow into a small calculus, and that the latter is composed of oxalate of lime, it follows that the dumb-bell or microscopic calculus has the same chemical composition. No difference in chemical character, refractive power, or in the action of polarised light, can be detected between the minute dumb-bell and oval crystal, and the aggregations of dumb-bells which are from time to time met with forming microscopic calculi. There cannot, in fact, be the slightest doubt of their being the same substance in different stages of deposition. Nor can there be any question of the latter being, in their turn, an early condition of the small renal oxalate of lime calculi.

Deposits associated with Oxalate of Lime. Oxalate of lime is often found associated with other deposits, particularly with urate of soda, in which case the minute crystals are easily passed over amidst the amorphous deposit, unless the latter be dissolved either by the application of heat or by the addition of a little potash previous to examination. The peculiar form of crystals of earthy phosphate described at the close of the last lecture are usually found in urine from which oxalate of lime is also deposited. Sometimes the crystals are so minute

that, without care, they may be readily passed over in a microscopical examination; and very frequently the only appearance observed in the microscope is the presence of clusters composed of minute cubical or square shaped crystals, which appear almost opaque. Indeed, such clusters of oxalate of lime crystals may be easily mistaken for urate of soda, from which, however, they may be readily distinguished by the fact of their not being dissolved upon warming the slide, and by their insolubility in potash and acetic acid. Crystals of this character are often found adhering closely to hairs and other substances. Deposits of oxalate of lime and uric acid are represented in the *Illustrations*, Plate xxi, Figs. 5 and 6; and of oxalate of lime and phosphate, Plate xxii, Figs. 5 and 6.

Of the Examination of Deposits of Oxalate of Lime by the Microscope, and of their Chemical Characters. The larger crystals are readily recognised by their microscopical characters; and the only crystals I have known mistaken for them are crystals of triple phosphate, as I mentioned when speaking of the phosphatic deposits. If, however, there be any difficulty, a drop of acetic acid will soon set the question of the composition of the crystal at rest.

Oxalate of lime deposits seldom sink to the bottom of the vessel in which the urine is placed, but seem to be buoyed up by the slight mucus deposit present. When, therefore, a drop of urine is taken for examination, there is no necessity for taking it from the very bottom of the vessel, the stratum of fluid slightly above this point being often found richer in crystals. Oxalate of lime seldom occurs in urine in sufficient quantity for chemical examination. If oxalate of lime be burnt in a platinum capsule, and the carbonised residue be exposed for some time to the dull red heat of a spirit-lamp or other flame, a white deposit will remain, which will be found to be insoluble in water, but it will be dissolved in acetic acid with copious effervescence, showing that, by the process of combustion, the oxalate has been converted into carbonate. If however, the carbonate has been exposed to a bright red heat, there will be danger of its partial or complete conversion into lime, in which latter case no effervescence will occur upon the addition of an acid. In the acetic acid solution, the presence of lime may be detected upon the addition of oxalate of ammonia, oxalate of lime being quite insoluble in acetic acid.

Of Oxalate of Lime in a Clinical Point of View. There is still much difference of opinion among practitioners as to the clinical importance of oxalate of lime. There can be no doubt that, in the majority of instances, the crystals form after the urine has left the bladder; and there is good reason for believing that the oxalic acid may be formed by decomposition of the urates after the urine has been passed. The experiments of Dr. Aldridge of Dublin showed that uric acid and urates were easily decomposed into oxalic acid and oxalates. Dr. Owen Rees entertains the opinion that this substance is derived from the urates; and that, when present in the urine, it indicates the existence of urates in the blood. This physician holds "that the oxalic diathesis is merely an accidental and unimportant modification of the uric." Oxalate is often deposited in the urine of gouty cases, and it is certainly very often found among urate deposits. We may consider it as proved that there are certain conditions of the system in which both oxalates and urates are formed, and that from time to time cases occur in which one class of salts predominates. In the same case, at one period we may find uric acid and urates; after a time, these mixed with oxalates; and lastly, they may give place to a deposit of oxalate alone. Wöhler and Frerichs injected uric acid into the blood of a dog, and found oxalate of lime in the urine. Oxalate of lime passes through the alimentary canal unchanged; but oxalic acid is in part excreted in the urine, while part is decomposed in the system. Bucheim and Piotrowsky have shown that small repeated doses of oxalic acid (fifteen grains every hour for six hours) are not poisonous. Not more than 12 per cent. of that taken by the mouth appears in the urine.

Oxalate of lime is, however, not always formed after the urine has reached the bladder. We saw that there was very strong evidence that in certain cases it was deposited in the tubes of the kidney, in the form of dumb-bell crystals; and it must therefore have been formed at the time of the separation of the urine from the blood, if it did not exist in solution in the blood itself.

It appears, then, that oxalate of lime may be excreted in the urine when oxalic acid or oxalates are taken in the food. It may be formed in the organism itself; and it may be produced by the decomposition of uric acid and urates after the urine has left the bladder.

Beneke has shown that the quantity of earthy phosphates and oxalates increases in direct proportion to each other. The nutrition of the tissues generally would be impaired under the same circumstances; and a larger amount of earthy phosphate would pass off in the urine dissolved by the oxalic acid. (*Archiv des Vereins*, Band 1, Heft 3.)

After what I have said, you will not feel surprised that the presence of oxalate of lime in the urine should afford us but little help in the diagnosis of the case. It is often discovered in almost opposite conditions. Thus it is sometimes present in poor broken down subjects, and it is found in the urine of well to do country gentlemen. It will appear when we live too well and take too little exercise. It is common in chronic pulmonary affections, as bronchitis; and it is often observed in old cases of emphysema. It is common enough in dyspeptics, and is usually met with in cases of jaundice. In various forms of general debility, in cases of overfatigue, and in men who have overworked their minds, it is perhaps the commonest urinary deposit. Lastly, I have found it many times, and in very large quantity, in the urine of men who appear in all other respects in perfect health.

It is impossible for me to enter into a discussion as to the treatment required in these cases. As a general rule, it will be found that anything which improves the general health and promotes oxidation will diminish the tendency to deposit oxalate of lime. Cold bathing, exercise, attention to diet, and the mineral acids, bitter tonics, and iron, are usually prescribed with advantage. When the dumb-bells appear frequently, it is desirable to promote their expulsion from the kidney, and prevent their formation, by giving mild diuretics with plenty of fluid; or two or three glasses of Vichy water daily will wash them out of the uriniferous tubes.

[To be continued.]

Illustrations

OF

HOSPITAL PRACTICE:

METROPOLITAN AND PROVINCIAL.

BIRMINGHAM GENERAL HOSPITAL.

CASES OF STRICTURE OF THE RECTUM OR LOWER PART OF THE COLON.

Under the care of JAMES RUSSELL, M.D.

Clinical Clerks—Messrs. MAY and PONCIA.

CASE I. J. W., aged 32, lamplighter, applied at the Hospital, to be treated for chronic diarrhoea. He states that he has never been free from purging for the last seven years; and refers the commencement of his illness to cold. Three months ago, he had a very severe attack, accompanied with pain, and was obliged to lie by for a fortnight. About a month afterwards, he was suddenly seized, on returning from work, with cramp in his bowels, legs, and thighs; and for the last three months he has frequently suffered from pain in his back and bowels, generally with a good deal of flatulence.

About a month ago, his complaint compelled him to leave work permanently; and, three days before admission, he had an attack of more than usual violence, accompanied with much straining, and intense pain in his back. On questioning him closely, it was ascertained that his bowels were constipated between the fits of purging, frequently for two or three days together; then diarrhoea followed, for three or four days, at the rate of seven or eight stools in the day, at first copious, and subsequently scanty. He describes his evacuations as having resembled barn in colour and appearance; they were fluid and frothy. He fancies he had piles when about sixteen; but has never passed blood in his stools. His habits have been temperate. His gums present no mark indicating the presence of lead. He is spare, but has a healthy aspect. His abdomen is very full and resisting; in the region of the sigmoid flexure of the colon the anterior wall is very prominent and full, and the prominence extends into the left flank, imparting to that region a very marked projection. The loin is normal. The prominent part is imperfectly tympanitic, but no fluctuation can be distinguished. A dose of castor oil produced an evacuation, of solid consistence, and of a dun colour; and the prominence previously noticed was entirely removed. He was