

FRUITNIGHT (J.H.)

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# URINARY CONCRETIONS IN CHILDREN.<sup>1</sup>

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ETIOLOGY.—Though urolithiasis may appear to be relatively an infrequent disease in childhood when compared with the whole number of children living, yet it is of special interest because the greater number by far of all the cases of this description is found among children. It is said that more than half of all the cases of calculus—and the vesical variety is the one especially meant—occur in childhood. Furthermore, when it occurs in children it is most frequent in those under five years of age. Nor are renal calculi so very infrequent in children, for the accumulation of uric acid in the kidney soon after birth may prevent the excretion of urine and may sometimes cause the formation of stones, which are occasionally found in very young infants. Thus Professor A. Jacobi has recorded that six times in forty post-mortem examinations of children under one year of age he has found renal calculi.

According to Roberts, of Manchester, England, of 1,827 persons who underwent lithotomy at various hospitals in England, 473 were under five years of age, and 528 were between five and fifteen years of age, hence more than fifty per cent. of these cases occurred before

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<sup>1</sup> Read at the Stated Meeting of the Northwestern Medical and Surgical Society of New York, January 16, 1889.



puberty. Dr. Geo. E. Post, of Beirût, Syria, has tabulated 176 cases of vesical calculus occurring in his practice, and 106 of these were in children under ten years of age.

As in adults, calculi are more frequent in the male than in the female sex. Barthez and Rilliet cite eight hospital cases, of whom six were boys and two girls. Neubauer found but five girls in one hundred cases of the disease.<sup>1</sup> Giraldes asserts that vesical calculus happens twenty-four times more frequently in boys than in girls.<sup>2</sup>

Though the fact is well established that the disease is more prevalent in some regions of the world than in others, as in the warmer zones for instance, yet no portion of the globe seems to be totally exempt from its presence. The negro race, however, is claimed to be remarkably free from calculous disease.

It has been observed that those children in whom calculi are found usually belong to the humbler classes, just the reverse of what obtains in adult life. According to the writings of Sir Henry Thompson half of the cases admitted to Guy's Hospital for operation for stone are children of the poor. He states, too, that it is almost never found among the children of the more favored classes. This has been explained by the fact that in consequence of the coarse and indigestible food of which they partake, and which is chiefly amylaceous in character, the children of the lower classes suffer from malnutrition, which is favorable to the deposition of urinary sediments. As more care and attention are paid to the diet and nutrition of the children of the better classes this cause is not operative in them. The absence of milk as an article of diet is supposed by some to tend to the formation of stone.

Scrofulous and tubercular children have also been con-

<sup>1</sup> Transactions of Ninth International Medical Congress, vol. i., p. 610.

<sup>2</sup> Jahrbuch der Kinderheilkunde, 1872, v., Heft 4.

<sup>3</sup> Cyclopædia of Obstetrics and Gynecology, vol. x., p. 192. New York: Wm. Wood & Co. 1887.

sidered as predisposed to this affection, and in particular rachitic children are claimed to be remarkably prone to be affected. Of the eight cases of Barthez and Rilliet, already alluded to, four were afflicted with tuberculosis of the encephalon, and one with acute tuberculosis associated with pulmonary gangrene. Vesical calculus has also been announced as among the sequelæ of measles.<sup>1</sup>

Heredity and family idiosyncrasy also seem to exert an influence in the occurrence of this disease, though by no means constant. A writer in the *London Lancet* for July 10, 1872, on page 204, reports a curious instance of this: "Six children of one family all had stone; the father and mother both passed quantities of uric acid, the grandfather and grandmother, a great-uncle, six uncles, four aunts, and one cousin had either all had attacks of gravel or were cut for stone."

Habits of life and nutrition play quite a prominent part in the causation of lithiasis. Habit naturally plays a more active part in adult life than in children, for the latter have not yet been confirmed in their habits, and it is therefore virtually without influence in early life.

Poor nutrition, already alluded to, favors the occurrence of lateritious deposits because of the abnormal composition of the urine under such circumstances.

The activity of the skin also enters as a factor of some influence in the production of urolithiasis; for the more active the skin is the more concentrated will the urine be, therefore the liability to calculus is increased because this liability stands in direct ratio to the amount of solid ingredients, and especially to the amount of uric acid which the urine contains.

The same general intrinsic causes are equally active in the child as in the adult. The concretion may be deposited in some one of the urinary organs from the unchanged urine because of some inherent vice in its composition. For instance, there may be present an excessive proportion of precipitable ingredients in the urine. The

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<sup>1</sup> Coulson: Jahrbuch für Kinderheilkunde, No. 440, p. 34.

urine may be too acid in reaction, thus diminishing its solvent power over uric acid and the urates. A deficiency of the chloride of sodium and the alkaline phosphates also reduces its power of holding uric acid in solution. Again, an ammoniacal decomposition of the urine in the lower urinary passages is favorable to the precipitation of the earthy phosphates and carbonate of lime. Acid fermentation of the urine with the mucous secretions of the urinary passages assuming the rôle of the ferment, is another cause of urinary concretions. Occasionally children may have a catarrhal condition existing in the pelvis of the kidney which will favor the formation of uric-acid gravel, and which may also lead to symptoms which correspond exactly with those of calculus pyelitis of later life. If this catarrh of the pelvis of the kidney should last a long time it might gradually spread through the ureter to the mucous membrane of the bladder, and as vesical catarrh notably favors the formation of stone, vesical calculi might be developed.

The presence of an abnormal substance of slight solubility in the urine, as cystine or xanthine, predisposes to the formation of calculi. The accidental presence of a body suitable to become a nucleus for the crystallization of urinary sediments, as a clot of blood, inspissated mucous epithelium, etc., or a foreign body introduced from without, as a needle, a piece of wire, a bone, etc., will also give rise to the formation of concretions. I do not, however, know of any case among children which originated in consequence of the introduction of a foreign body from without.

That certain diatheses—as the rheumatic, gouty, or darts—exist in children, as in adults, favorable to the occurrence of these urinary deposits is to my mind problematical.

*Pathology.*—These concretions are most generally formed in the kidneys, whence they often pass into the bladder, where they increase in size and weight, and occasionally into the urethra. They are very seldom indeed formed in the urethra, but if found there they have been

almost invariably arrested in their passage from the kidneys. They also may occasionally originate in the bladder. Urethral calculi occur especially in children. As has just been remarked, they are derived for the most part from the bladder or the kidneys, being calculous fragments which have been arrested at the narrowest part of the canal and lodging more especially at the bulbous portion or fossa navicularis. In some very rare instances the concretions may be formed in the urethra. Thus there may be a constriction in the canal behind which the urine may collect and deposit some of its salts—a nucleus is formed, usually of uric acid, and the evolution of a urethral calculus has begun. Again, the arrest of one or more gravelly particles may also give rise to the formation of urethral calculi. Dr. Fewsmith, in vol. xv. of *The American Journal of Obstetrics*, refers to a case of primary urethral calculus in a boy one month old which was apparently of intra-uterine growth.

Concretions may also form just within the prepuce, particularly if the latter be long and tight, and hence they are known as preputial calculi. These calculi may consist of inspissated smegma or of true urinary deposits. The latter variety may either have been formed here in a manner similar to what obtains when a urethral calculus develops *in situ*, or it may have escaped from the urethra into the preputial canal.

In newly born infants uric-acid infarctions are nearly always found in the kidneys. These are insignificant in extent, and they very rarely disturb the renal functions. The opinion which formerly prevailed, that these infarcts of uric acid were found exclusively in children who had breathed, has been demonstrated to be false. Indeed, they have been observed in the kidneys of still-born children, and even in those of the non-viable foetus.

The presence of these infarctions in newly born infants is explained as being caused by an increased physiological tissue metamorphosis, which is induced after birth by the establishment of the processes of respiration, digestion, and calorification. These infarctions are rarest in those in-

fants who die very soon after birth. They are more frequent in those children who have lived twenty-four hours, and most frequent in those who die between the second and fourteenth day after birth. Then until the end of the second month there is a steady diminution in the number of cases presenting specimens of these uric-acid infarctions, though Virchow has remarked their presence even in the period extending from the third to the fifth month of life. They are to be found, however, only in the minority of the kidneys of the newly born. In fact, these infarctions are met with in less than fifty per cent. of the newly born infants, which proves that the conditions assuring their production must be inconstant. Concretions have also been detected in the kidneys in foetal life. Langenbeck has discovered a calculus in the bladder of a six-months foetus, demonstrating that they may be formed in intra-uterine life.

The calculi met with in children are most commonly composed of uric acid or the urates. Those consisting of the urates, and especially of the urate of ammonia, are most frequently found in nurslings. Ebstein denies the assertion that oxalic-acid concretions are more frequent in children than in adults. He refers to the case of a girl, seven years of age, who passed two large calculi whose kernels were uric acid, though their shells and middle layers consisted of oxalate of lime. If the urine be very concentrated, very hard uric-acid concretions will be produced by the depositions of concentric layers of that substance, and which may vary in color.

Cystine concretions are very rare in children, although Hodann removed a large one of this variety from a boy, six and a half years of age, by lithotomy. Xanthine and fibrine concretions, so far as I am aware, have not been observed in children; nor, according to Heller, have true phosphatic stones or the earthy phosphates been found in children. Carbonate-of-lime calculi, which are so extremely rare even in adults, have never been seen in children. When the concretions are formed in the urethra they are, as a rule, phosphatic in composition.

Renal calculi are usually few in number, but one or two being present. Of the vesical variety, one is generally found, but at times several may be present in that viscus. Erichsen says that he removed from a child, four years of age, a large conglomerate concretion formed of eleven distinct uric-acid calculi matted together, besides which three others were found free in the bladder. Sometimes a calculus in the bladder is broken, and its fragments become nuclei for other calculi. In the bladder the calculi are generally loose, but they may become fixed by encystment in the sacculi of the vesical mucous membrane.

The size of these concretions in children ranges from that of a pea to a good-sized marble. Quite large calculi are often met with in very young female children.

The weight of a calculus does not depend so much upon its size as it does upon its chemical composition. It may weigh in children from a grain or two to a fraction of an ounce. Recently formed calculi are heavier than older ones, because they retain more moisture. Macnamara removed one weighing one quarter of an ounce from a child four years of age, which is unusually heavy for one removed from so young a patient.

The shape depends upon the structure and the composition of the concretion, though it is usually irregular. Vesical calculi are more ovoidal. When formed in the urethra they are elongated.

The color of a calculus, too, depends upon the chemical nature of the ingredients forming its enveloping crust. Calculi are also said to have a characteristic odor.

Their consistency varies from that of soft sand to that of hard marble, and depends upon their chemical composition, the amount of moisture present in them, and their molecular cohesion. Uric-acid calculi, which, as has already been stated, are the most frequent in children, are hard. In all varieties the outer shell is always the softer portion, while the nucleus is the denser.

Calculi when found singly are usually smooth, but when

two or more are found together their surfaces may exhibit facets as a result of their attrition. Their mode of growth is seen in the consecutive deposition of the successive layers of which the concretions consist. I shall omit a description of the processes of chemical analysis of the various urinary concretions, because it does not strictly fall within the line of this paper.

*Semeiology.*—Though the uric-acid infarcts, which are so frequently present in the newly born, are usually washed away more or less speedily in the first month or two of life, some of the detritus may remain in the tubules and pelves of the kidneys, and by its presence an irritation will be produced which will cause disorder in micturition.

Infants undoubtedly suffer from nephritic colic as well as adults, though such a diagnosis is seldom made. The little one will suddenly become restless, it will then writhe in pain, all the time screaming wildly. After a while these symptoms will subside, and they are obviously relieved with every micturition. The same observations can be made in older children who have constantly recurring violent and apparently inexplicable screaming spells. These attacks depend frequently upon the presence and elimination of gravel and renal calculi.

The little patient suffering from urolithiasis will strain in its efforts to pass its water. There is intermittent urination accompanied by pain. In the intervals the sufferer is serene and undisturbed. In very young children if the napkin be examined it will exhibit dark reddish or yellowish stains, and occasionally gravelly crumbs can be felt. This brown dust is found oftener on the napkins of the puny infant than on those of the robust. The burning caused by the hyper-acidity of the urine is felt not only in the urethra but also at the meatus, the glans, and the labia.

In older children we have to deal more with newly formed concretions or gravel, rather than with infarcted uric acid. In such cases the discharge of urine is occasionally stopped entirely, and only a few drops are voided

despite the most severe straining. In some cases retention may last from thirty-six to forty-eight hours with enormous distention of the bladder, extending sometimes even above the symphysis pubis, catheterization being necessary to relieve the patient. In other cases there is a constant trickling of urine from the urethra. The vicinity of the genitals is continually wet, and an odor of stale urine prevails. As a result inflammatory and œdematous conditions of the parts follow. If the urine of children, although clear when voided, lets fall a crystalline deposit before it has completely cooled, as is often seen, there is danger of the formation of a stone.

Older children fall into the habit of pulling and playing with the penis in consequence of the irritation of the disease, and in that manner attempt to relieve their distress. In these boys the prepuce becomes unusually long and developed.

In cases of vesical calculus the symptoms, it is true, depend somewhat upon the size and weight of the stone, but not absolutely. A sudden stoppage of the flow of urine occurs at times. Again, there may be increased frequency of micturition. Hæmaturia, though extremely rare in children, may be present. There is intense vesical tenesmus, with pain in the bladder and penis. The young suffer more from stone in the bladder than adults do. Priapism occasionally occurs. Frequent defecation accompanies stone in the bladder in children, in fact, fæces are often passed at every micturition. As a consequence of the severe straining in which the child indulges in order to pass water, prolapsus ani not infrequently occurs. There is a departure from the normal chemical composition of the urine. The following history illustrates what has been described :

Willie M——, aged two and one-half years, was brought to my office one morning complaining that his urine had suddenly stopped, and that now he could not pass any. I gave him a simple diuretic, but the symptoms of distention of the bladder increased, and I diagnosticated a stone in the bladder. I advised the mother to take the

child at once to the hospital, where the diagnosis was confirmed, and on the following day the patient was subjected to median lithotomy, which resulted successfully in the cure of the disease.

If the stone lie loosely in the bladder, the child will, in order to escape its suffering and to pass its urine more easily, lie on the back or on the side, as the force of gravity will cause the stone to fall away from the neck of the bladder when such a position has been assumed. Sometimes, if the stone be free and small enough, and provided it assumes a proper position as regards the relative direction of its longest axis and the long axis of the urethra, the calculus may be expelled spontaneously. Such a case came under my notice last year.

E. S—, aged seven years, complained that at times, when he was urinating the flow would suddenly cease, which was accompanied by pain. Straining did not cause a return of the flow. After he had run about for a time the urine would again be voided. One day when he had retained his urine longer than usual, as he expressed it, "a longish white worm" passed from him. This body was undoubtedly a calculus, which was the diagnosis that had been made.

When the concretion is arrested in the urethra, which happens quite often in boys, the symptoms are mostly mechanical in their nature. Complete retention of urine always occurs. Oedematous swelling of the genitals then ensues. Frequently the calculi can be felt in the urethra by manipulation. Two cases of this description came under my observation within a short period of each other, whose histories I will briefly narrate.

CASE I.—G. B—, at the age of two and one-half years, had had an obstruction to the flow of urine. He was examined by Professor Jacobi, who found a stone in the bladder which he removed by lithotomy. When the boy was nearly five years old I was called to see him because he could not pass his water. In examining him I detected under my fingers a hard body in the course of the urethra, about one-half inch behind the corona glandis, and which

caused the boy pain when it was squeezed. He was placed under ether, and by manipulation I was enabled to force it forward to a point within reach of the grasp of a long pair of dressing-forceps, with which the foreign body was extracted. It proved to be a urinary concretion.

CASE II.—G. K—, aged three years, was passing water when suddenly the stream stopped and a whitish body partially protruded from the urethra. His parents were much alarmed and sent for me. The case was at once recognized as a urinary calculus impacted in the urethra. It was easily removed from the canal with an ordinary pair of dressing-forceps. Both children were then treated for urolithiasis for an extended period of time, and no more gravel or stones were developed.

If the stone be impacted in the deeper portions of the urethra very serious results often follow. For if the retention of urine be prolonged and relief be not quickly afforded, the irritation may eventuate in abscess, sinus, and urinary extravasation in the perineum, and finally incontinence of urine will succeed the irritability of the bladder.

*Diagnosis.*—The diagnosis of renal colic in infants is manifestly difficult. It is very likely that often when intestinal colic has been diagnosed the child is really suffering from nephritic colic. Hence it is proper when a child is very restless and its actions denote pain to examine its napkins for the reddish-brown stain characteristic of urolithiasis. If dysuria be present the napkins should also be examined for the lithic sediment. If small concretions should be found in the diaper or in the urine of older children, it is advisable to explore the urethra and bladder of the anæsthetized patient. Every case of chronic dysuria, whether it be associated with vesical catarrh or not, should be thus examined in order to determine the presence or absence of calculi, as the exciting cause of this continued difficult and painful micturition. The predisposition to lithæmia is only detected after gravel or concretions have actually been found.

When the stream of urine is abruptly checked we may

reasonably suspect the presence of a stone either in the bladder or in the deep urethra. But if we are in doubt the bladder should be examined in the usual manner with the sound in order to clinch the diagnosis.

Prolapsus ani in older children is a symptom which should not be undervalued for its indication of vesical calculus as a possible exciting cause. Priapism, too, in small children, should draw our attention to the possible presence of stone in the bladder. The presence of blood in the urine of children should certainly lead us to suspect the presence of calculous disease.

When called to a child suffering from retention of urine always suspect a concretion impacted in the urethra. For in boys the impaction of calculi in the urethra is almost the sole cause of urinary retention. In order to verify the diagnosis a physical examination of the perineum, and per rectum, should be made. Furthermore, in order to test the permeability of the urethral canal, it should be explored with a probe, and thus the diagnosis will be conclusively settled. Finally, error in diagnosis from lack of symptoms is not likely to occur, because in children these are generally more obvious than in the adult.

*Prognosis.*—The prognosis of this affection is much more favorable in childhood than in adult life. Simple gravel is nearly always cured. Still the uric-acid infarcts of infancy may occasionally be the first cause of a secondary nephritis, this disease being the result of actual irritation or real injury inflicted by the gravelly particles in the urine. The attacks of renal colic always end in recovery. Nor when concretions of appreciable size have formed are they *per se* necessarily fatal. Their direct results may, however, tend to unfavorable complications which will modify the prognosis in special cases.

The disease is more fatal in the male than in the female sex. Dr. William Roberts states that in the nine years from 1857 to 1866, in England and Wales, only 116 deaths among children occurred from calculous disease, which, it must be admitted, is a very small ratio. The

rate of mortality of this disease among children is so low because they are usually seen early, and because proper measures of treatment can thereupon be instituted with more hope of success than later in life. Moreover, when operative procedures are resorted to, the prognosis is nearly uniformly favorable, for they are usually pre-eminently successful. Indeed, lithotomy in boys under the age of puberty is, perhaps, the most strikingly successful of all the great operations in surgery.

In regard to urethral calculi, it can be said that, if they are not located in the deeper portions, the prognosis is very favorable. If, however, they be seated near the bulbous portion, then the complications which may possibly attend them render the prognosis more grave, though not necessarily fatal.

*Therapeusis.*—The treatment of lithæmia in children is, as in adults, dietetic, medicinal, and surgical. In order to diminish the density of the urine, which, it will be remembered, encourages the lateritious deposits, and also to lessen the irritation of the kidneys, considerable quantities of water should be allowed. This recommendation applies as well to young infants as to older children. Parents generally do not seem to realize that the young child can become thirsty, and will require something to slake its thirst as well as older people, for we seldom meet with parents who give their infants water to drink. In older children other aqueous beverages and diluents may be permitted. Also, when from the previous voidance of concretions or gravel we are led to suspect a tendency to the formation of such deposits, we should, as a prophylactic measure, order copious drinking of fluids, the variety of which, whether alkaline or otherwise, must be determined by the chemical composition of the foregoing deposits.

The diet of older children should consist mainly of milk, the white meats, eggs, and farinaceous articles of food. Still the fear of azotized substances should not be carried too far in the regulation of the diet. Our object, in other words, should be to limit but not to restrict the

ingestion of nitrogenous foods. Naturally the foods permitted must be easy of digestion.

• Warm baths are to be recommended, because of the increased nutritive changes promoted by them. The bowels should be kept free. Whatever induces to an improvement in the general hygienic environment of the patient, including good air, food, clothing, etc., should be strongly insisted upon.

When acute paroxysms of nephritic colic attack infants and children they must be cut short by the exhibition, in sufficient doses, of the weaker preparations of opium, such as the camphorated tincture or papaver syrup.

Medicinal treatment should be directed toward the prevention of the formation of concretions when a tendency thereto is apparent, and toward the solution and consequent facility of expulsion of concretions which have already been formed. Hence it has been designated as the solvent treatment. The solvent treatment consists in the administration of alkalies or acids, according to the solubility of the deposits in alkalies or acids. In carrying out the solvent treatment, when the urine abounds in uric acid and its compounds, which is the usual condition in children, we must bring it up to a certain degree of alkalinity by the continuous administration of alkaline remedies, for these medicines are somewhat slow in their action. Among the alkaline remedies the acetate of potash and the citrate of potash are well thought of. The carbonate and citrate of lithia may also be given, likewise the carbonate of potash. All these medicines should be largely diluted with water in their administration, and the doses apportioned to the age of the patient. The phosphate of soda and ammonia, in doses of from gr. ij. ad gr. v. ter in die, according to age, has also been prescribed with benefit. The phosphate of soda—which also acts well on the bowels of children—benzoic acid, and the benzoate of soda may be given in the same doses. Nor should the liquor potassæ be forgotten. The alkaline mineral waters, such as the natural Vichy, Bethesda, clysmic, Buffalo lithia, and others may also be recom-

mended. The oxalate-of-lime concretions also demand an alkaline treatment. So long as the urine when voided continues sweet, the alkalies may be given, but should it become ammoniacal, then they must be discontinued lest a deposit of the earthy phosphates occur. The milder diaphoretics and diuretics can also be advised.

In phosphatic deposits the acid treatment is the proper one ; but as these deposits are not met with in children its consideration will be dismissed with these few words.

In children these solvent remedies should always be administered per orem. Though vesical injections may be feasible in children, it seems to me that, inasmuch as we can obtain all desired therapeutic effects by the internal administration of the medicines, such injections should be discountenanced. Besides the direct action of these solvents upon the delicate mucous membrane of the child's bladder involves a certain amount of danger to it.

We may conclude, therefore, that the solvent treatment is applicable in cases of simple gravel, and in the early period of the formation of concretions, but that it ceases to be so when the urine becomes ammoniacal, and secondary deposits accumulate on the surface of the stone.

But when the stone, and the uric-acid variety in particular, is of considerable size, the solvent treatment by medicines will avail nothing, and recourse must then be had to the art of surgery. As a detailed description of the various resources which the science of surgery has developed for the cure and relief of these maladies is not embraced in the scope of this article, I will content myself with merely calling attention to certain salient conclusions, which are the outcome of the experience and observation of many distinguished and skilful surgeons.

Neither the operation of nephrotomy, for the removal of a calculus impacted in the kidney, nor the operation for the removal of one impacted in the ureter has ever, so far as I can learn, been done in the person of a child. The question of its feasibility I cannot discuss, but must submit it to the judgment of the surgeon.

In the past the operation of median lithotomy for vesical calculus was preferred for male children, as it gave the best results. For female children, dilatation of the urethra, with subsequent lithotripsy, was the chosen mode of operation. Recently published reports, however, seem to show that the operation of litholapaxy is growing in favor as a promising operation for both male and female children, and it may in time supplant the two first-named operations for the majority of cases of vesical calculus.

When a concretion has become impacted in the urethra a gush of urine will sometimes force it out. If it remain fixed, the urethra should be dilated, and the offending body should then be extracted with proper forceps. If, however, the stone be of large size and deeply seated, an incision in the urethra may be necessary in order to facilitate its extraction. Care should be taken that it be not pushed back into the bladder. When the concretion has ulcerated through the urethra, incise the resulting abscess, remove the stone, and then treat the wound on general antiseptic surgical principles. The treatment of preputial calculi is so obvious that it does not need elucidation. Yet it may be proper to suggest the advisability of circumcision in certain cases of redundant prepuce, in order to prevent their formation.



