

"STONE FORMATIONS IN THE HUMAN BODY." ¹

(Particularly Bladder, and Kidney Stones as found in the Thai).

by

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Stone formation in the human body forms one of the most interesting subjects in medicine. The condition is apparently as old as the human race and has been mentioned in ancient medical treatises of many countries. I am presenting this subject before you to-night from the standpoint of a keenly interested observer. As a physician doing special work in X-rays and Radium, my interest lies primarily in the finding of these stones, their shapes, sizes and situations, and also their probable composition. Because they are really stones in every sense of the word, hard and heavy, etc., they absorb the X-rays and cast shadows upon the films well visible even to inexperienced eyes. But for accurate diagnosis one must understand their nature better; the various causes that go into their formation greatly influence their ultimate composition. All these points account for my bold venture rather far away from my particular field. But, in medicine there is really no definite boundary between all the special branches. The interest of one merges into another with such perfect blending that the line of demarcation is imperceptible. Thus, I am still within my rights to speak on the subject.

It is my purpose, this evening, to present to you facts and fancies concerning this stone formation, especially about those found in the urinary tract: how they are formed, the means for locating them, the various factors that influence their formation, their treatment and also possible prevention.

VARIOUS KINDS OF CALCULI.

Calculi or stones, strange as it may seem, may occur in many parts of the human body, hollow organs being the chief sites. General and local influences undoubtedly play a role in the deposition of stone-forming materials. Parts other than hollow organs are teeth, the dental tartar being composed of calcium phosphates and also a certain amount

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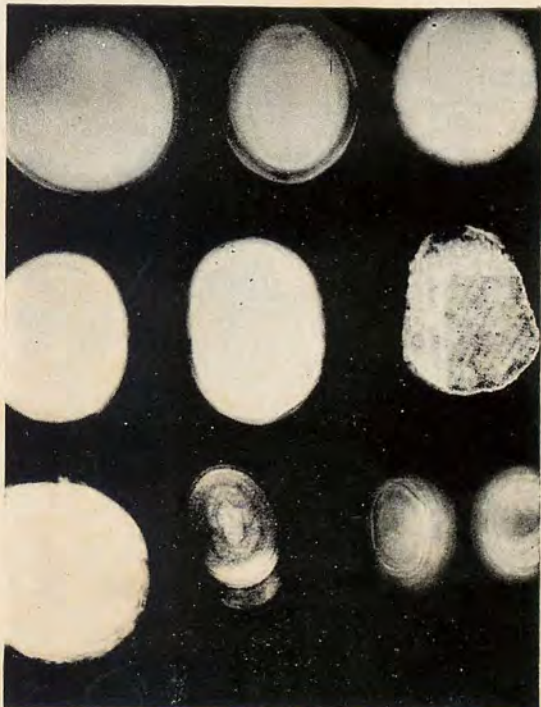
of organic matter. In gout, deposits consisting of sodium or calcium urates are often found in lobes of ears and in edges of joints in hands and feet. The so-called "enteroliths" or intestinal calculi are often found in man, but quite frequently also in the horse or cow, consisting principally of magnesium phosphates. Other sites in the human body, that may contain small stones, are the tonsils, prostate gland, ducts of salivary, pancreatic and mammary glands. In the pineal body, a small rounded structure, situated in the centre of our brain, believed to be our third eye by occultists, there are often found small minute concretions, the so-called "brain sand-granules" or technically "corpora arenacea." These granules also consist of phosphates and carbonates of calcium and magnesium. One of the most frequent localities in the human body for calculi formation is the biliary tract. These gall-stones are well-known to all of you here, I am sure. They are usually not made up of lime salts as in other stones, but mainly of cholesterol. Therefore these gall-stones are not hard and do not cast shadows on X-ray films, unless they contain an extra layer of calcium.

BLADDER STONES.

Among all the locations in the human body, the urinary tract forms the most frequent site for stone formation. Before going further into the subject, I would like to have you personally acquainted with these so-called calculi or stones first. This interesting collection has been loaned for this occasion through the kindness of Dr. Prajaksh Tongprasert, head of the Department of Surgery at Siriraj Hospital. We located these stones for him and he took them out. Most of the larger ones really required no X-ray examination, they could be felt even from the outside. These are all bladder stones which are very prevalent in this country. The largest one here weighs over half a kilogram. Fig. 4. The largest recorded in literature measured 6" in diameter, weighing over 4 lbs. The largest one on record at Siriraj was about one kilogram, unfortunately that specimen is not in this collection. The smaller ones are called "pebbles," because they really look like and feel like pebbles. The small particles are called "sands," also because of the resemblance. You may note that the shape and size show very wide variation. Fig. 1. Most are, however, egg-shaped having a smooth contour. Occasionally they are cubical in shape, being packed close together in large numbers. In one of our cases, there were 77



1. Bladder Stones of different size and composition.



2. Xray view of Bladder Stones, showing internal lamellate structure.



3. Children with Bladder Stones from different parts of N. E. Thailand.



4. Huge Stone in Human Bladder. (Stone weighing over 1 pound)



5. Stones in Human Kidney. (Upper-right corner).

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stones or rather pebbles of varying sizes. If only these were pearls, then matters would certainly take on a different aspect. We would then have reasons to be envious of those having the largest ones and would not mind having one ourselves! But mind you, the so-called pearls are really calculi the same as these. The only difference is that the human body cannot make pearly substances, so lays down earthy salts instead, making our pearls absolutely valueless and very undesirable!

FORMATION AND COMPOSITION.

Chemical analysis of these stones reveals that they are composed of several constituents, the chief ones being lime salts in the forms of calcium phosphate, carbonate and oxalate; others are cystine, uric acid and xanthine. One stone may be composed of one or more of these constituents. Stones composed of calcium salts are the hardest and heaviest and cast dense shadows on X-ray films. Cystine stones have a density higher than that of water, so are barely visible. Uric acid and xanthine stones are not dense and therefore do not cast any shadows, unless they contain an extra layer of calcium. The fact that stones in the urinary passages are made up of lime salts in one form or another, makes examination by the X-rays the most useful and accurate means for their detection. I have here roentgenographs of a few of the specimens shown to-night. You may see that almost all of them cast very dense shadows, with the exception of the last two which are barely visible. The second film was obtained by special technic to show the various layers of the deposits which are characteristic of bladder stones. Fig. 2. These stones always start from a central nucleus which may be a clump of bacteria, epithelial cells or some foreign bodies that find their way into the bladder by one way or another, or the nucleus may be a small piece of a stone passing down from the kidney above. Once started, successive layers of salts are deposited upon the surface and, with the binding substance produced by inflammatory changes and irritation, the stone gradually grows. Thus, the primary or original formation and the peripheral layers are often quite different in composition. Because of this difference in composition, the various layers are usually well-visible in the form of concentric rings, quite analogous to tree-rings. The number of tree rings indicate the age of the tree in years, while the rings

in bladder stones indicate the number of times the acute inflammatory process has occurred in the bladder.

KIDNEY STONES.

Kidney stones take entirely different shapes ; larger ones show branching with irregular outline, typical of the so-called "Coral Calculus." Fig. 5. A small stone or a small bit broken off from a large one may pass downward into the ureter and on into the bladder below ; while passing a severe colic is produced.

CONCEPTION OF STONE FORMATION.

Now, I think you may have some idea as to the physical side of these stones. The next question to come up is, why all these stones? Isn't it a wonder that not every one of us has them? I shall pass on the various disease processes in the body which account for a small percentage of stone formation in the urinary tract, because these are interesting only from a medical standpoint. Most of us, I am sure, have noticed that urine at times contains sediments of tiny crystals which are composed of uric acid, calcium oxalate or various phosphates, yet rarely do any of these cases ever show any tendency towards stone formation. The question as to the probable causes of these formations has been considered even in the remote ages. Medical records written in the reign of the powerful Chinese Emperor Huang Ti, B. C. 2697, when Chinese medicine was at its heights reveal that the stones were then thought to be caused "by unusual seasonal influences. Extremely hot weather might upset the body, so that the eyes and face swell and the individual is sleepy. Urine is yellowish red!" And, in a later period of Chinese medicine, the stones were said to be due to "an excess of the 'yin' or negative principle which heats the urine, so that it becomes concentrated and stones are formed. This is caused by excessive sexual relations, fits of rage, alcoholism or over-nutritious foods....." Now, we know definitely that foods are the chief factor, but in an opposite direction from what the ancient Chinese had believed,—not the over-nutritious foods but poorly balanced foods lacking in many essentials, verging on a starvation diet. This direct relationship between the formation of urinary calculi and the absence of certain essentials from the diet, has been

proven beyond doubt by studies of the living conditions in 'stone areas' of many countries, and also by animal experimentations.

STONE AREAS IN OTHER LANDS.

McCarrison has found that a definite stone area exists in India, and Joly has also found that in England stones occurred most frequently in Derbyshire and in Westmorland. In the United States, there are also definite stone areas in south Florida and southern California with a question of one along the border of New Mexico. India, China, Egypt, the East Coast of England, the Valley of the Volga in Russia and recently in Dalmatia on the shore of the Adriatic, all have been found to have definite stone areas. In China, the southern provinces of Kwangtung, Anhwei and Shangtung are known to have more bladder stones than any others, while these stones are a rarity in the fertile plain of Manchuria. When these stone areas are carefully considered, it is found that in all of them, there is a definite deficiency in the diets of the inhabitants. The deficiency is not alone in Vitamin A, but also often times in Vitamin B. In general the people live on a poorly balanced diet. It has been found also that in certain countries there is a marked decrease in the incidence of calculus disease in children during the last century, because living conditions have improved. Since the last World War, there has been an increase in the incidence of stone formation in certain parts of Europe, and this is explained by the fact that invading armies did not have adequate commissaries, so that the inhabitants existed on deficiency diets for a considerable time. However, the incidence of urinary calculi has been considerably reduced, following improvement in nutrition.

STONE FORMATION IN EXPERIMENT ANIMALS.

The experiment works of McCarrison, Osborn and Higgins have demonstrated the relationship between a deficiency of Vitamin A and the production of urinary calculi in experimental animals. In China research workers confirmed this relationship and further found that besides a Vitamin A deficiency, additional Vitamin D excess is also an important factor. Almost 100% bladder stone occurrence was obtained in mice fed on this type of diet.

STONE AREAS IN THAILAND.

In Thailand, apparent stone areas also exist in many parts of the country; Terr Snitwongse has reported an area in the north-eastern provinces about the region of Ubol. I regret to say that to my knowledge up to the present time, no actual surveys have been made to locate stone areas of our country. There is no question that urinary stones are very prevalent in Thailand, including a wide section. A rough survey of patients with such stones, coming to be treated at Siriraj Hospital by the Department of Surgery, discloses a startling result. These patients came from many parts of the country including within a wide strip and extending from the north-eastern section right through the central provinces down to Bangkok. The McCormick Hospital of Chiangmai also reports large number of stone cases coming for treatment. Ubol and surrounding regions have been known to be a stone area for a long time as reported in the Public Health records. Hundreds of operations for removal of bladder stones have been performed in a year at hospitals of Ubol and Korat. During the year B. E. 2481, the X-ray Department of Siriraj Hospital examined 643 patients for diseases of the urinary system; stones were found in 314 of these cases. Children 10 years of age and under made up 94, out of the 314. The youngest was only 3 months old with a small stone impacted in the urethra. Almost all of these 314 cases received surgical treatment. Young children always form a greater percentage of the cases from the north-eastern section of the country. It is a common sight at Siriraj Hospital, during the months of February and March, to see flocks of people from Korat, Ubol, Khonkaen, Buriram and the surrounding area, each one carrying a child between 5 and 10 years of age. Fig. 3. The child is usually male, scantily clad, every once in a while screaming and pulling at the external genitalia, being unable to pass the urine. This constant pulling causes much elongation of the organ, a very characteristic and sure sign of bladder stone. X-ray examination of the urinary tract always reveals stones in the bladder in all of these cases, some having even more than one, others having additional stones in the ureter or kidney as well. Surgical removal is done in all cases, and all are able to return home in a few weeks. Although hospitals have been established in Ubol and Korat and such treatment may be received there, large number of them still

come to Bangkok every year. When asked for the reasons, similar replies are always obtained, i.e. they want to come to the same place, where others have been cured. And, to my mind, a sight-seeing trip to the capital must be another motive. But this may mean another thing—an overflow from those rural hospitals.

SYMPTOMS OF STONE OBSTRUCTION.

Really, such a sight saddens one's heart. Is there anything to be done to relieve the sufferings of these young people? There are few other pains comparable to pain of a bladder stone, coming on scores of times during the 24 hours year-in and year-out, devitalizing and racking the whole system, consequently the life span is much shortened. However, when an ordinary physiological act becomes an ordeal, life is certainly not worthwhile living. The stone is a foreign body and on growing larger produces an obstruction. Eventually kidney function is impaired little by little, leading to complete destruction. When this chief organ of elimination cannot function, the whole human mechanism also ceases to operate and death is the inevitable result. But, before death comes, the sufferings are indescribable. Patients are known to bump their heads against walls, because of the pain produced by inability to pass the urine. One patient recorded in literature had to stand on his head every time he urinated, thus relieving the pressure of the big stone from the neck of the bladder, and allowing the urine to pass out. Various positions are assumed by patients on walking, standing or sitting just to ease the pain. The constant straining in children also produces prolapse of the rectum, a common complication in these cases.

SPECIFIC CAUSES IN THAILAND.

This section of the country is densely populated, containing several millions of inhabitants. There is no doubt that a large percentage of this population is afflicted with this condition. In the United States, the economic loss to the country brought about by common colds, has been estimated at several hundred million dollars every year. Urinary stones are a disease of much longer duration, producing much sufferings to the afflicted. The economic loss brought about by this condition is unestimable, the whole short life being practically useless.

Before taking up the treatment and prevention, let us consider the various factors that operate in other countries, and whether the same factors also exist in this stone area of our country. Living conditions in the north-eastern section are evidently below average. The daily monotonous menus are rather meager, consisting of glutinous rice, decayed fish in the form of the 'Pla-rah,' salt and red pepper. There are practically no deciduous crops of vegetables being grown. The vegetables eaten are those that are found growing wild and young leaves of edible trees. Among this list, red pepper is about the only one having vitamin A. The 'Pla-rah' has only small food value. Fresh fish and other forms of meat are certainly rare delicacies. These people have to subsist on these diets, mainly because of poverty and habits. Drinking water is obtained from wells, in the form of chalky water which is being consumed without boiling. This hard water may be the source of excessive calcium intake. There is practically no source of vitamin D in the diet. But these people, especially the children, are scantily clad, the sun's rays shining directly on the skin several hours a day. The ultra-violet rays from the sun provide an abundant source of vitamin D. Thus, every factor ideal for stone formation, seems to be present: 1. deficient food, 2. excessive calcium intake from drinking water, and 3. vitamin D excess from the sun's rays.

TREATMENT — REMOVAL

The treatment of urinary stones has been most unsatisfactory ever since the dawn of medicine. Ancient Chinese have advocated many drugs, such as barks of elms, malachite, and piper nigrum, all of which have some action on the urinary tract, but certainly not on the stones. And for night-blindness, often associated with stones, such obnoxious agents as bat, sparrow, and other animal excreta were recommended. These are not as foolish as they seem, because examination with modern means has revealed that these excreta contain a certain amount of vitamin A. And this is easily explained; the vitamin A taken into the body in foods is not completely assimilated and absorbed by the body, and a certain amount passes out as such in the excreta. In modern medicine, there have been found only few drugs that have direct action on the causative agents of diseases, such as

quinine for malaria, salvarsan and allied preparations for syphilis and emetine for amoebic dysentery. In conditions with still unknown or uncertain causes, we try to relieve the symptoms by medicines and by surgical means, which is the next best thing to do. We remove the appendix when it is found to be diseased. We destroy tumours by X-rays or radium, or by surgical removal if such is still possible. It is a case of cutting off the diseased finger to save the rest of the body. In urinary stones we also remove them to relieve the obstruction which is producing distressing symptoms, as a temporary palliative measure, at the same time giving little or no thought to the agents that are responsible. In all these years, surgical methods have been perfected and delicate instruments devised for operative removal and crushing of these stones, to such an extent that few other conditions have received similar attention. But to what result? Patients may be symptom-free for variable lengths of times. It may be years. Sooner or later, however, the same symptoms reappear. This is because recurrence can occur after any type of operation. The same causes that have led to the first stone, may again operate to produce another. We also cannot ensure that poor patients will have good foods rich in vitamin A and sound medical care for the rest of their lives. Thus any form of treatment is still not entirely satisfactory. The hope lies in prevention.

PREVENTATIVE MEASURES.

In this country, I believe I can see the hope of completely eradicating this condition fully realized in the near future. Success will mean much to our nation; our man-power will be greatly strengthened; a very important and vital factor in the prosperity of any nation. At first, accurate surveys should be undertaken to locate all the stone areas. People should be thoroughly examined for evidence of stones, and the X-rays should be an indispensable means of examination. Living conditions in these areas, especially the diets should be gone into very thoroughly. Stone from the various areas must be examined and analyzed by expert chemists. The Government Laboratories of the Department of Science may be a great helping hand in this task. The knowledge of the chief constituents of these stones in various localities is quite essential in the treatment and formulating plans for prevention. Research stations may be es-

tablished in conjunction with the Faculty of Medicine, in the different stone areas to help in the studies. Campaigns should then be launched to stress the importance of proper foods and water as preventive measures. The far-sightedness of the present Government is doing much towards this much desired end. The proposed construction of wells throughout the country will ensure good drinking water for the people. Additional campaigns to teach them to boil their drinking water will eliminate, not only the diseases contracted through water, but will help in lessening the hardness of the water, thus preventing in a way the excessive calcium intake through this medium. The recently promulgated acts concerning compulsory kitchen gardening and poultry farming are producing good effects to the country in more than one direction. To my mind, these are one of the most enlightened and wisest policies of H. E. Luang Pibul Songkram's Government.

FUTURE PROSPECTS.

Good and proper foods for the whole country are definitely ensured, the kinds of foods providing all that has been lacking. With improved living conditions and nutrition of the people, I am quite certain that within the next ten years at the most—with rigorous enforcement of these laws—these stone areas will be completely wiped out from the country.

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