RENAL CALCULI

*Transcription of a Panel Meeting**

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Panel Members

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Chairman

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MODERATOR MARSHALL: Although it is probably not necessary to introduce the panel members to you, we shall go through the formality. They are all excellent urologists and have been selected because of studies they have made on renal calculi or because of special interest in this field.

The first is Dr. Francis P. Twinem, the Chief Urologist at Lincoln Hospital. He has been interested in calculous disease for a number of years and has studied recurrence rates. Next is Dr. George W. Slaughter of Lenox Hill Hospital, whose particular reason for being on this panel is that he has developed what appears to be an excellent method for removing staghorn calculi. Dr. Gordon Oppenheimer, of Mt. Sinai Hospital, has been interested in recurrence rates for different kinds of stones and especially in recurrence rates following different types of operations for their removal. The end man in this show is Dr. Robert M. Spellman of St. Elizabeth's Hospital in Boston. He is imported, not only to add a touch of youth, but also because he has made a special study of the Shorr program for the prevention of certain types of calculi.

We decided to have a panel meeting instead of a symposium, because we believe in this way we might cover the more interesting, yet not closely connected, questions and especially a variety of controversial matters that have to do with renal calculi.

Dr. Twinem, considering all the patients with renal stones in the New York area, what percentage of first or original kidney stones are composed principally of cystine?

DR. FRANCIS P. TWINEM: The percentage in one large series was 2 per cent, and this corresponds quite well with other studies. Some records show 1 per cent or less.

MODERATOR MARSHALL: *How frequent are uric acid and urate stones?*

DR. TWINEM: Uric acid stones constitute about 5 per cent.

MODERATOR MARSHALL: *Oxalates?*

DR. TWINEM: We frequently get mixtures of oxalate and phosphate; but considering those that are predominantly oxalate in the ureteral and renal stone group, they constitute about 40 per cent.

MODERATOR MARSHALL: *How about phosphatic stones?*

DR. TWINEM: Phosphatic stones make up most of the remainder, which would be about 53 per cent. These figures, of course, are approximate and they vary in different parts of the world. Patients in southern

Asia have more uric acid stones than occur in the New York area. The figures, too, would be somewhat different for bladder stones.

MODERATOR MARSHALL: *Suppose we consider only recurrent stones, or more properly the patient who has had numerous recurrences, the "stone-former". Do these percentages change, in New York City again?*

DR. TWINEM: Yes, in recurrent stones there tend to be many more phosphatic ones.

MODERATOR MARSHALL: *About how many more?*

DR. TWINEM: There aren't so many of the oxalate stones that recur. The exact percentage, I do not know, but in cases of recurrent calculi we estimate that about three quarters of them are phosphatic. I have never compiled any precise figures on the recurrences alone.

MODERATOR MARSHALL: *What percentage of staghorn calculi are of cystine composition?*

DR. TWINEM: In the series that I studied they were 6 per cent of the staghorn calculi. This is a higher figure than for stones generally because a rather high proportion of cystine stones are of the staghorn type: for instance, in the eight cases of cystine stones that I can recall, four were of the staghorn type.

MODERATOR MARSHALL: *I am a little surprised at that. I hadn't thought of it as being quite that high. Do all cystinurics get calculi?*

DR. TWINEM: No, not by any means. Only about 2½ per cent of cystinurics actually develop calculi.

MODERATOR MARSHALL: *You say that about 6 per cent of staghorn calculi are cystine in type. About what percentage are phosphatic?*

DR. TWINEM: The percentage that are phosphatic is quite high, because there aren't many calcium oxalate stones—at least, large pure calcium oxalate stones. Very few stones that are pure calcium oxalate are of the staghorn type. Although I have no precise figures, my estimate would be that probably more than 80 per cent of staghorn calculi are of phosphatic or at least of various phosphatic combinations; about 20 per cent would be pure calcium phosphate.

MODERATOR MARSHALL: *You have some pictures of a staghorn calculus of cystine. Would you like to show these briefly?*

(At this point Dr. Twinem showed and described a few slides concerning cystine calculi.)

DR. TWINEM: This is a rather unusual case of cystine calculi. I saw this boy when he was 16 years of age. He had a history of having passed

a small stone when he was six months old, and again when he was 14 years old. Here is the picture which we found at the age of 16 (large bilateral calculi). There was much argument as to whether this boy should be subjected to surgery at all, but we did operate upon him. Here is a recent x-ray of this boy, taken 18 years after the operation. He is now 34 years of age, has three children, and is active. He has been treated in a simple manner, being on an alkaline ash diet and taking simple medication as indicated, to keep his urinary pH above seven. On a few occasions he has had renal lavage, but how much good that has done I don't know. For a long time I could find nothing that would cure his urinary tract infection with B. lactis aerogenes. About a dozen different antibiotics were tried but finally Ilotycin accomplished the desired result.

While we are showing slides I shall anticipate things a bit. This slide shows the percentage of recurrences in the opposite kidney where there has been an operation for renal calculus. Here are 102 cases of pyelotomy with three recurrences in the opposite kidney. Also, here are 100 nephrotomies with 28 per cent recurrence in the same kidney but only two appearances of stone in the opposite kidney. When a nephrectomy was done in 48 cases, there was recurrence in the opposite kidney only in two, or 4.2 per cent.

MODERATOR MARSHALL: *Do you think cystinuria tends to run in a family?*

DR. TWINEM: Yes, that is correct.

MODERATOR MARSHALL: *You mentioned the young man had three children. Have any special studies been done on these children?*

DR. TWINEM: No, the children have not been studied. I am just about to take up that matter.

MODERATOR MARSHALL: *Dr. Slaughter, do you agree with what Dr. Twinem has said so far?*

DR. GEORGE W. SLAUGHTER: I do.

MODERATOR MARSHALL: *Dr. Slaughter, what about hyperparathyroidism as the cause of renal calculi? How many of the patients with calculous disease not only have hyperparathyroidism but also have the hyperparathyroidism as the cause of the stones?*

DR. SLAUGHTER: I think hyperparathyroidism is a very *uncommon* cause of urinary calculi. There is much more hyperparathyroidism being verbally tossed about than is actually present in patients having

stones. The minute you mention stones, everyone begins thinking of hyperparathyroidism.

MODERATOR MARSHALL: *Considering the stones in staghorn calculi, what percentage might be the direct result of hyperparathyroidism?*

DR. SLAUGHTER: Not a single one of those whom I have operated upon, except perhaps the most recent one which has not yet been studied in this regard.

MODERATOR MARSHALL: *Dr. Oppenheimer, is your experience about the same?*

DR. GORDON D. OPPENHEIMER: My experience with renal calculi associated with hyperparathyroidism leads me to believe that it is a rare condition, but I do think it may occur in somewhere between .2 per cent and 1 per cent of all cases of renal calculi. This probably depends somewhat on the care with which the cases are worked up.

MODERATOR MARSHALL: *Dr. Spellman, what tests ought to be done in looking for hyperparathyroidism?*

DR. ROBERT M. SPELLMAN: I haven't had experience with hyperparathyroidism but I looked up the excellent paper by Black of the Mayo Clinic which was published in 1953. He reviewed 112 cases of hyperparathyroidism and found that 73 of them developed renal calculi. He didn't distinguish between nephrocalcinosis and renal pelvic calculi. He seemed to believe hyperparathyroidism can be ruled out if two determinations of serum calcium and serum phosphorus levels are normal. He didn't seem much impressed with the 24-hour determination of calcium in the urine, since it is subject to so many variations.

MODERATOR MARSHALL: *Did he make mention of the serum proteins? My understanding is that calcium is partially attached to these proteins. If the serum protein level is not determined you may not get a true picture.*

DR. SPELLMAN: Yes, a significant amount of measurable calcium is combined with the serum protein, so that if you have an abnormal serum protein the determination of calcium alone could lead to significant error. For example, if the serum proteins are low there would be a distinct tendency for the serum calcium also to be low, a situation which could co-exist during the variable phases of hyperparathyroidism.

MODERATOR MARSHALL: It is my impression that the measurement of the 24-hour output of calcium in the urine is a quite valuable diagnostic test, provided the patient is on a standardized diet.

DR. SPELLMAN: This would be laborious as a routine screening test. Certainly, the urinary levels would gain in significance if the patient were on a standard diet, and I would guess that Black also thinks so. He did, however, stress particularly the calcium and phosphorus levels in the serum.

MODERATOR MARSHALL: There are other tests, of course. Dr. Ephraim Shorr, who is here tonight, has been working on this problem for some time and has developed what appears to be a useful test. It is a calcium tolerance test. Our clinical experience with the test is so limited that I, as a urologist, cannot adequately comment upon it. We have searched and tried all sorts of blood tests, yet we find only the rare patient with stones who also has hyperparathyroidism.

Dr. Slaughter, if hyperparathyroidism is corrected will stone formation stop?

DR. SLAUGHTER: I do not think so.

MODERATOR MARSHALL: *What do you think, Dr. Twinem?*

DR. TWINEM: I think it will. I think that there will be less likelihood of recurrence.

MODERATOR MARSHALL: *What do you think, Dr. Oppenheimer?*

DR. OPPENHEIMER: I think that if you would remove all the stones from such a kidney, so that there will be no remaining calculi and if you also remove the parathyroid adenoma, no stones will form in that kidney due to hyperparathyroidism.

MODERATOR MARSHALL: In other words, it really depends a great deal on the status of the kidneys at the time you remove the parathyroid adenoma.

DR. OPPENHEIMER: That is obvious.

MODERATOR MARSHALL: If the kidneys are in good condition, stone formation would stop and that statement is probably 90 per cent true. I have had no great experience but we have had a few such patients.

Dr. Spellman, if renal function has already been affected adversely will renal function improve if the hyperparathyroidism is corrected?

DR. SPELLMAN: I think you must make a distinction between various renal complications of hyperparathyroidism. One of these is nephrocalcinosis and another is renal pelvis stones. Unfortunately, once nephrocalcinosis has reached the phase where renal failure is measurable, then removing the adenoma has only a slight effect on improving renal function. In other words, renal failure then may well continue progressively

to death. Nephrocalcinosis is the most feared complication of hyperparathyroidism.

MODERATOR MARSHALL: In other words, the status of the kidney at the time the parathyroid adenoma is removed has much to do with the future course of the patient. If the kidneys are in good condition, function will usually return and the stones usually won't return. If the stones are still there, and especially if the renal parenchyma is severely affected as in nephrocalcinosis, there is likely to be steady progression to renal failure.

Dr. Slaughter, in the causation of staghorn stones, what do you think is the role of obstruction-infection? Stones in the bladder are primarily the result of obstruction (plus the residual urine) and infection. How many staghorn stones form in the kidneys on this same general basis?

DR. SLAUGHTER: A small percentage. I think that infection, rather than causing it, usually follows the stone formation.

MODERATOR MARSHALL: *What percentage of staghorn stones occur bilaterally?*

DR. SLAUGHTER: In my experience, about 20 per cent.

DR. SPELLMAN: In Dr. Slaughter's paper reviewing 80 cases of dendritic calculi, 16 were bilateral. We recently reviewed a series of 18 cases of staghorn calculus and three of these patients had bilateral stones. Dr. Edward Brady of Bellevue Hospital found three of 19 were bilateral. Accordingly, the 20 per cent figure is probably correct.

MODERATOR MARSHALL: *Dr. Twinem, do you have any facts, theories, or opinions as to why one kidney may develop a staghorn calculus while the other kidney does not? We usually think that what circulates through one kidney circulates through the other, and investigators have spent much time talking about what is going into the renal machinery to produce the particular stony exhaust.*

DR. TWINEM: In the case of phosphatic stones, which are in the majority, I think that local factors are important. With cystine stones, I think there must be a definite metabolic factor. There is a much higher percentage of bilateral cystine stones than of bilateral phosphatic stones. Some local factors must be involved, because only about 14 per cent of stones are bilateral. If stone formation were due largely to metabolic causes, one would expect that both kidneys would be equally subjected to the same metabolic factors and that there would then be a much

higher percentage of bilateral stones. The fact that this is not the case seems to indicate that local factors are of great importance.

MODERATOR MARSHALL: *Can you mention two or three of these local factors which you have in mind?*

DR. TWINEM: There may be local factors in the form of poor drainage of a kidney, which may be the result of stricture at the ureteropelvic junction, infundibular narrowing, unusual calyceal dependencies, marked angulation of a calyx, or infection of the whole kidney or of one calyx only.

MODERATOR MARSHALL: *Do you accept Randall's plaques as an explanation?*

DR. TWINEM: I don't profess to know much about Randall's plaques. They appear to be a reasonable explanation for some calculi. I do not believe they can account for all of them.

MODERATOR MARSHALL: Randall's observations were most interesting, but thus far that remark describes them nearly completely. People pay lip service to his work, but there does not seem to be much confirmation, so far, and certainly little of a practical clinical nature has developed from that study as yet. Recently, in the *British Journal of Urology;* there was a report of a somewhat related account of causation having to do with the formation of microliths in the renal lymphatic system.

Dr. Spellman, what do you think is the most interesting current theory about the formation of ordinary kidney stones?

DR. SPELLMAN: Apparently the etiology of kidney stone formation will become clearer as further facts concerning the physiology of collagen material and epithelium are revealed. There appear to be three materials in the kidney that contribute to stone formation: the connective tissue; the lining tissue or mucosa; and the serum containing the calcium and phosphate ions. These materials combine in some way to produce a stone which is, as we know, composed of mineral crystals held together by a matrix.

MODERATOR MARSHALL: I have heard this matrix spoken of as "uromucoid".

DR. SPELLMAN: The matrix of a stone is much like the matrix of bone or osteoid tissue. Since an actual progressive stone is not produced by the simple salting out of calcium and phosphate crystals in a supersaturated solution, something else is required to hold these crystals

together. This other material seems to be a sticky, sugar-protein combination, and apparently it can be found free in the urine. On this account, Boyce has called it uromucoid. Recent investigations seem to show that the level of this material in the urine is elevated three to 13 times in patients with hyperparathyroidism or renal infection, in those on cortisone or ACTH medication, in patients with repeated stone formation, and in experimental animals subjected to repeated stress. There seem to be several varieties of this mucoprotein in the urine. Boyce thinks that the physical properties are related to the state of polymerization. With depolymerization into smaller molecules the affinity for calcium is thought by Boyce to increase greatly.

MODERATOR MARSHALL: *All this is a new idea?*

DR. SPELLMAN: It certainly is.

MODERATOR MARSHALL: *Where does this mucoprotein come from? Is it merely filtered through the kidney?*

DR. SPELLMAN: This mucoprotein molecule is apparently of tremendous size, and I would think it unlikely that it would go through a normal glomerulus.

MODERATOR MARSHALL: *How do you think it might get into the urine?*

DR. SPELLMAN: A major disease of the nephron might permit it to pass, but there is no evidence that such disorder regularly precedes calculous formation. The material can be broken into much smaller molecules and I presume that this might occur across the urinary mucosa. After studying this problem Dr. Roger Baker believes that calculous formation has three important steps: first, an increase in the amount of ground substance (possibly mucoprotein) under the tubular epithelium; second, calcification of this material; and third, a similar process taking place simultaneously in the lumen of the tubule.

MODERATOR MARSHALL: There is a lot of interest in this matter, but we cannot go on with it now, especially as we don't know enough. We have transplanted transitional epithelium as a free graft in experimental animals to investigate further the physiology of the mucosa. This transplanted mucosa does elaborate a fluid which apparently stimulates true osteogenesis in certain connective tissues of the dog. We also have some incomplete evidence that the fluid elaborated by the mucosa contains material very similar to the mucoprotein studied by Boyce. Clinical application of this information is, however, not yet apparent.

DR. TWINEM: I would like to ask Dr. Spellman why these disease processes, or at least abnormal occurrences, should not affect both kidneys equally.

DR. SPELLMAN: That is a good question, which I cannot answer, except to say that the opposite kidney forms a calculus much more frequently in a patient who has had a stone than in those others in the general population.

MODERATOR MARSHALL: *Dr. Oppenheimer has looked up recurrence rates. What are the recurrence rates of renal calculi?*

DR. OPPENHEIMER: In general the recurrence rate seems to vary from 4 per cent to 60 per cent.

MODERATOR MARSHALL: *What is the recurrence rate for different kinds of stones?*

DR. OPPENHEIMER: Before I give any statistics, an explanation of terminology is indicated. I am not sure, for instance, that when I say that stones are bilateral in 25 per cent of cases it means the same thing as when Dr. Twinem says they are bilateral.

MODERATOR MARSHALL: *What do you mean then when you say 25 per cent?*

DR. OPPENHEIMER: In my statistics, which were reported in *Surgery, Gynecology and Obstetrics*, December 1937, I explained that bilaterality meant the appearance of calculi on both sides at any time during the life, and/or while the patient is under observation. I am sure that the incidence of bilaterality is less than 25 per cent because this figure refers only to in-hospital patients.

Also, when we talk about recurrences, we must differentiate between true recurrences and pseudo or residual recurrences. The total recurrence rate is the sum of the true recurrence rate plus the residual or pseudo-recurrence rate. The residual recurrence rate is the rate of recurrence in a kidney where radiography shows that stones have been left behind after operation. This is determined by x-raying the patient shortly after the operation.

MODERATOR MARSHALL: *What were these rates?*

DR. OPPENHEIMER: The true recurrence rates in all types of cases for pyelolithotomy, pyelonephrolithotomy and nephrolithotomy were respectively 14.9 per cent, 32.0 per cent and 29.4 per cent. The total rates of the true recurrences plus the residual recurrences were 24.0 per cent, 54.0 per cent and 58.6 per cent respectively. In unilateral cases

the true recurrence rate for all conservative operations in the primary stone cases (calcium oxalate or calcium oxalate-calcium phosphate) was 8.1 per cent; while in the secondary stone cases (mixed calculi, salts of the alkaline earths) it was 28.3 per cent.

MODERATOR MARSHALL: *The recurrence rate of uric acid calculi was not stated. Many of them are tiny things and are rarely seen in our offices. Also, we frequently fail to get an accurate follow-up in such cases. Dr. Oppenheimer, do you have another reason in mind?*

DR. OPPENHEIMER: Another reason is that one often cannot tell radiographically when there *is* a recurrence of the uric acid stone.

MODERATOR MARSHALL: *What is the recurrence rate of staghorn phosphatic calculi?*

DR. OPPENHEIMER: The true recurrence rate of phosphatic or dendritic stones was 30 per cent, but the total recurrence rate was about 60 per cent.

MODERATOR MARSHALL: *That 60 per cent includes the false recurrences, the little pieces left behind that later grew?*

DR. OPPENHEIMER: Sometimes large pieces are left behind.

MODERATOR MARSHALL: *Accordingly, a great deal depends on whether the removal of the staghorn has been really complete?*

DR. OPPENHEIMER: That's right.

MODERATOR MARSHALL: *Dr. Twinem, do your studies indicate essentially the same figures as those given by Dr. Oppenheimer, and are the figures of the Lincoln Hospital about the same?*

DR. TWINEM: Yes. In the series that I studied, recurrence of staghorn calculi was about 40 per cent when checked by x-rays a few years postoperatively.

MODERATOR MARSHALL: *Dr. Oppenheimer, what measures do you use to insure the complete removal? That is, do you always take x-rays in the operating room?*

DR. OPPENHEIMER: I wish I knew how to prevent residual calculi, because I believe we would get better results and have fewer recurrences if we could accomplish complete removal of all stones.

MODERATOR MARSHALL: *Would you tell us your little tricks?*

DR. OPPENHEIMER: I think the most important measures are to operate slowly and to palpate carefully when finished, to explore the calyces with stone forceps and scoops, and to irrigate with a catheter. I have often seen small stones washed out of the kidney pelvis with irrigation.

Operative x-ray control can help locate the stone fragments which are not palpable. I think operative x-ray control should be used much more often than it is at present.

MODERATOR MARSHALL: *How often do you use it?*

DR. OPPENHEIMER: We try to use operative x-ray control for all complicated or dendritic stones.

MODERATOR MARSHALL: It is a cumbersome procedure and it is sometimes difficult to line up the personnel.

DR. OPPENHEIMER: It is cumbersome. Recently, I had some false hopes about a portable source of radiant energy, a little lead box with a shutter which we tried to use as a source of radiation. Our roentgenologist said it wasn't very practical, but it would be a very nice thing if one could have a little box instead of the bulky portable x-ray machine.

MODERATOR MARSHALL: *Something like a flashlight?*

DR. OPPENHEIMER: Yes,—to put in front of the kidney, open the shutter, get your picture, and have it back in a few minutes.

MODERATOR MARSHALL: *Have you used Dees' coagulation pyelolithotomy?*

DR. SPELLMAN: I have used it twice. The first time it didn't work well, most likely because of my inability to follow the instructions properly. The second time it worked well. It surprised me. It formed a nice, heavy clot, which on extraction contained numerous small stones within it.

MODERATOR MARSHALL: We have used it about a dozen times altogether. At least three or four failures have been the result of what Dr. Spellman has described as technical difficulties. Since one doesn't use it often, the possibility of getting the procedure confused, and hence a poor result, has been significant. Three or four of the 12 were really beautiful operations. If there is a small, narrow opening into one calyx, the stone may be too large to come through even if it is solidly within the coagulum. Actually, I think the method should be studied more carefully and used by a variety of urologists.

DR. OPPENHEIMER: Isn't it true that you sometimes accidentally use the same method when there is bleeding?

MODERATOR MARSHALL: Yes.

DR. OPPENHEIMER: With good results?

MODERATOR MARSHALL: Yes, we do have clots in our kidneys—

rather too often, I might say.

Dr. Slaughter, you are the authority on technique for removing these staghorns. How does one go about it?

DR. SLAUGHTER: I think the movie will best demonstrate the technique.

(At this point a color motion picture was shown of the removal of staghorn calculi.)

In bisecting the kidney we really mean bisecting it. I think you will see this as the picture progresses. In the past 14 years I have not removed a single kidney for stones. In the movie here you see how much pressure lies back of the stone within the kidney. Although it does not show here in the film, we have put on a Doyen clamp at the pedicle. I find this the most satisfactory instrument for that purpose. I have never once removed the clamp during the procedure. I believe that it is entirely unnecessary to take off the clamp. If you do, you lose five or six minutes while the blood is draining from the kidney. Recent work shows that no damage will result to kidney function within two hours after applying the clamp to the pedicle. One hour and 18 minutes is the longest time I have left the clamp in place. In that time we have removed 2,500 small stones from a kidney; and I am glad to say we got them all. I have, however, left stones behind. I do not hesitate to go back immediately if a patient is found to have stones remaining—certainly before the patient leaves the hospital. It is my opinion that if we do not remove all the stones the operation is a failure and should not have been attempted in the first place.

MODERATOR MARSHALL: *How avascular is Broedel's line?*

DR. SLAUGHTER: There is such a line. On four occasions in the last 150 attempts we have hit Broedel's line, and it wasn't the last four cases either. It is rather spectacular when you hit it, and if you do, there is absolutely no bleeding when the clamp is removed. It is fantastic, but it's true.

MODERATOR MARSHALL: *How did you pick the line in those four cases?*

DR. SLAUGHTER: The same way I picked all the other 146!

MODERATOR MARSHALL: That is a 2.6 per cent success rate.

DR. SLAUGHTER: About that.

(Concurrent comment during showing of film.) The kidney is exposed in routine fashion. It doesn't make too much difference how you

expose it, but it is important to preserve the capsule at all cost.

The kidney at this point is bisected along Broedel's line. There have been many methods suggested for the opening of the kidney. You will notice that we open it sharply from end to end, and it is really open. It is not a "medical incision"! I never close the kidney without going back four times and exploring each calyx with my finger. I find that the most satisfactory way to find all the stones. One can usually feel them. Here we are actually opening a calyx by sharp dissection. The calculus is exposed. This next stone was down pretty close to the pelvis. Here it comes out. It looks not unlike a lobster. You might also note that a gallbladder spoon was used. A gallbladder spoon is really an excellent instrument for getting all small stones out of the calyces. Here are the stones. These little arteries should be identified and closed with small mattress sutures. You need not worry about the veins but you do need to worry about the arteries because they will really give trouble.

MODERATOR MARSHALL: *In cases of split kidneys, how many times have you had to go back and remove the kidney in the early post-operative course?*

DR. SLAUGHTER: I have never gone back and had to remove the kidney. I did go back on one occasion because the sutures used gave way. This was ten years ago. I went back and repaired the kidney again and the patient made an uneventful recovery.

MODERATOR MARSHALL: *We have split 18 kidneys and have had to take out three for hemorrhage. We probably could have gotten by with one. Why do you think we have had such hemorrhages?*

DR. SLAUGHTER: I don't know. I wonder if you used all three stages of this operation. The capsular suture should be placed first. If it is not, you will never be able to place it properly.

MODERATOR MARSHALL: It is true that we haven't usually used a capsular stitch.

DR. SLAUGHTER: During experimental days I did leave out the capsular suture to see what would happen. About eight days postoperatively we had a fair amount of bleeding. I believe that the hemostatic suture, which you will see in a moment, gave way. The capsule was not there and the kidney then opened up. I think one should use the capsular suture and use ribbon gut instead of ordinary catgut. Ribbon gut effects more solid compression rather than localized compression.

With the capsular suture in place, we are now ready to put in the hemostatic sutures. They consist of a piece of ribbon gut on either side around which the mattress sutures are pulled tightly so that it gives compression not only at the point of suture but also gives compression between these points. Now the ribbon gut is being placed. I have operated in hospitals where they did not have ribbon gut and have taken six or eight plain strands of catgut and used that in place of ribbon gut.

MODERATOR MARSHALL: *I have left a nephrostomy tube in place after a split, usually for two weeks. Doesn't your suture go through the ribbon gut?*

DR. SLAUGHTER: It does not go through the ribbon gut. Formerly I used to put it through the ribbon gut, but that is difficult and actually serves no useful purpose.

You will find that you will have urine draining from the nephrostomy tube long before the wound is closed.

I think you should use all the steps. The vessels within the kidney must be sewn; you must approximate the capsule; and you must use the ribbon gut, or its equivalent, so that you have continuous pressure.

MODERATOR MARSHALL: *Dr. Slaughter, how many times have you left stones behind, that you could detect by x-ray, after this technique?*

DR. SLAUGHTER: Very few, actually, but it is a long hard process to make sure they are all out.

MODERATOR MARSHALL: *Dr. Spellman, how many stones did we leave in the 18 splits that we did?*

DR. SPELLMAN: We left two.

MODERATOR MARSHALL: Two pieces of stone in 18 cases, that seems fairly good.

DR. SLAUGHTER: May I ask, did you go back and take them out?

DR. SPELLMAN: No, we didn't. The patients had had enough—and we too!

MODERATOR MARSHALL: We did not use the capsular stitch regularly. We did try to follow every other step. I must say, however, that although I was not greatly impressed with the capsular stitch it now appears that we should "put up or shut up" since Dr. Slaughter's program has worked out significantly better than ours.

Dr. Slaughter, would you be deterred from splitting a solitary kidney?

DR. SLAUGHTER: No, I have split a solitary kidney on nine occasions.

One of these cases is of interest: A patient called me from Paris one morning at 4 o'clock and said he had a solitary kidney and had been in anuria for 36 hours. I told him to get on an airplane and come over, and that's what he did. I split the kidney, put in a nephrostomy tube, allowed a lower ureteral stone to pass, and the patient made an uneventful recovery.

DR. OPPENHEIMER: Did Dr. Slaughter say he split the same solitary kidney nine times?

DR. SLAUGHTER: No, I have split nine solitary kidneys.

MODERATOR MARSHALL: *Which kidneys would you not split?*

DR. SLAUGHTER: I have never seen a kidney I would not split.

MODERATOR MARSHALL: *Have you seen a kidney that you would not split, Dr. Twinem?*

DR. TWINEM: Oh, yes.

MODERATOR MARSHALL: *Quite a few?*

DR. TWINEM: I don't look with quite the same degree of complacency on splitting a kidney as George Slaughter does. Yes, I think if you have a dendritic calculus and the patient is 65 years old and that calculus is causing no trouble, the function of the kidney is good, no infection is present——

MODERATOR MARSHALL: *How often do you see a staghorn with no infection?*

DR. TWINEM: You see that in about 15 per cent or 20 per cent of cases. In the case just described I would let the staghorn calculus remain. But there are some I would not split because I would perform a nephrectomy.

MODERATOR MARSHALL: *How about splitting the solitary kidney? Dr. Slaughter said he split them with no hesitation.*

DR. TWINEM: I would split it under certain circumstances.

MODERATOR MARSHALL: *Not as readily as Dr. Slaughter, I gather. Would you split it as readily as Dr. Slaughter, Dr. Oppenheimer?*

DR. OPPENHEIMER: About half as readily.

MODERATOR MARSHALL: *How about you, Dr. Spellman?*

DR. SPELLMAN: About two-thirds as readily.

MODERATOR MARSHALL: I would not split kidneys quite as readily as Dr. Slaughter and certainly not as readily if that were the patient's only kidney.

DR. SLAUGHTER: I am frank in confessing that I would not split a

solitary kidney unless and until I was absolutely sure of my method. I had done about 40 splits before I did the first solitary kidney. Perhaps I am a little over-confident, but the nine have worked out extremely well.

MODERATOR MARSHALL: *Have any of your patients developed hypertension postoperatively?*

DR. SLAUGHTER: None.

MODERATOR MARSHALL: *What is the recurrence rate following extensive nephrolithotomy with the usual prophylactic measures such as antiseptic drugs and increased fluids?*

DR. SPELLMAN: Dr. Edward Brady, of Bellevue Hospital reviewed 19 extensive nephrolithotomies for dendritic calculi. It is safe to say they weren't put on any major prophylatic treatment. He found an 80 per cent recurrence rate, which is a little higher than the percentage that has been stated tonight.

DR. TWINEM: May I add something here? I wouldn't split some kidneys for the reason that I would remove them. If you have a kidney with a staghorn calculus associated with infection and the other kidney is free of stone, and has always been a good functioning kidney, never infected, never the site of stone formation, I believe that the best you can do then is to remove the kidney with the dendritic calculus. As to recurrence, I will take a bet with anybody that if you take any series of splits for staghorn calculi and follow the series for four years and check the patients with x-ray, that you will find a recurrence rate of 25 per cent as a minimum.

MODERATOR MARSHALL: *What do you think the recurrence rate would be in two years? I ask that, because we have some figures.*

DR. TWINEM: In two years it would be definitely less. There is quite a difference. Sutherland, in England, studied 89 cases of stone recurrence in which only 25, or 28 per cent recurred in the first two years. The others recurred later than two years. Fifty-eight per cent of the recurrences were within five years.

MODERATOR MARSHALL: *What is the recurrence rate in the opposite kidney after a split, two years later, or perhaps in four years?*

DR. TWINEM: The recurrence rate in the opposite kidney was 4 per cent following operations for dendritic calculi.

MODERATOR MARSHALL: *In the opposite kidney?*

DR. TWINEM: Yes.

MODERATOR MARSHALL: *Dr. Oppenheimer, have you seen spontaneous dissolution of calculi?*

DR. OPPENHEIMER: I have, but before I present that matter I have a case I would like to tell you about. I think we should stress the point that our recurrence rates depend upon the length of follow-up. I would also like to point out to the audience that the article by Dr. Sutherland, in the *British Journal of Urology* for March, 1954, mentioned by Dr. Twinem, reports probably the best set of recurrence statistics that I have seen since Dr. Twinem and I wrote similar articles. Do you agree?

DR. TWINEM: Since you wrote yours!

DR. OPPENHEIMER: We have all tried to dissolve stones, using especially Suby's solution, generally with equivocal success. In our hands the acid ash diet with Vitamin A has been unsuccessful, although I know Dr. Higgins has reported some successes.

The patient whom I wish to tell you about was a 49-year old Turkish Jewess who first came under observation on our ward service about 1949 with a 10 year history of bilateral dendritic calculi. She was also a mild diabetic. Both kidneys were infected and showed some diminution of function. Salmonella Montevideo was cultured from the urine. Other investigations gave essentially negative results. She had a right nephrolithotomy with residual calculi, in spite of operative x-ray control. Later a perinephric abscess formed, was drained, and was followed by a temporary right renal fistula. The films showed a gradual spontaneous disappearance of the untreated left dendritic calculus until only a dense nucleus 3 x 2 cm. and one smaller concretion remained. This occurred over a period of one and a half years. Recently I read an article on experimental urolithiasis in which stones did not form on a vesical foreign body infected with an unusual Salmonella. Whether the diabetes and infection are related to the dissolution of the stone can only be conjectured. I referred the patient to Dr. Shorr so that he might investigate her from the metabolic point of view.

MODERATOR MARSHALL: *Does an acid ash diet, in your opinion, prevent phosphatic stones?*

DR. OPPENHEIMER: I don't know, but I doubt it.

MODERATOR MARSHALL: *Dr. Spellman, how does hyaluronidase control recurrence?*

DR. SPELLMAN: My brief experiences with hyaluronidase have been failures.

MODERATOR MARSHALL: *What place has partial nephrectomy in prophylaxis and prevention of recurrence?*

DR. TWINEM: I think it is a very valuable procedure when stones have formed in the tip of a calyx which has poor drainage by reason of a strictured infundibular portion or by reason of dependency and angulation with the pelvis—where a dysuric type of calyx is present. I began doing partial nephrectomies in 1937, and have found that one rarely gets a recurrence if the kidney is of the type in which there is one such calyx while the others drain well. The largest series I know of was reported by Dr. H. H. Stewart of Bradford, England. He reported 87 cases of partial nephrectomy checked two to 13 years postoperatively with x-rays. He found a recurrence rate of 6.8 per cent, which I think is quite good for a large series.

MODERATOR MARSHALL: *In other words, you think for selected cases it is highly desirable?*

DR. TWINEM: Yes.

MODERATOR MARSHALL: We will now touch on the Shorr regimen, not only because we are much interested, but also because Dr. Shorr is here in the audience.

Dr. Spellman, in your experience, how effective is the Shorr regimen? How does a 1300 milligram phosphatic intake in 24 hours with 40 cc. of aluminum carbonate gel (Basaljel) work out? I should also add,—with examination of the 24-hour urines to make sure that you are getting the desired effect. How effective has that program been in reducing recurrences following a split for staghorns of the type that Dr. Slaughter has shown? We have said that somewhere between 25 per cent and 80 per cent will recur in a period of approximately two years probably nearer the higher figure.

DR. SPELLMAN: From our experience, the program is very worth while. We have reviewed 18 consecutive extensive nephrolithotomies from the New York Hospital. Eleven of these patients were faithful to the regimen and were followed for an average of three and one-half years. Not one of the 11 had a recurrence in that period. Three nephrectomies were necessary, as already mentioned by Dr. Marshall. Two patients were complex, one with hyperparathyroidism, and so will be omitted for brevity now. One of the remaining patients was sent home and inadvertently not placed on the Shorr regimen. Within three months she developed a recurrence and was then placed on the regimen.

The stone failed to grow during the next two years. The stone was then surgically removed and there has been no recurrence while the patient has been on the program in the subsequent three years of follow-up. A more important case, however, was that of an alcoholic with bilateral staghorn calculi. He had complete bilateral nephrolithotomies. The patient did not follow the Shorr program originally and had recurrences. When the program was subsequently followed, the stones stopped growing. Later he stopped the program and the stones began to grow again. While reviewing the literature I discovered a similar case discussed by Dr. Elmer Hess.

MODERATOR MARSHALL: We are fortunate to have Dr. Shorr's laboratory to aid us in following these patients. It is not a perfect program, for a number of reasons, and I am sure that once in a while there will be a patient who doesn't respond. Dr. Twinem has had one such individual, whose phosphatic stones grew in spite of the patient being on the program, but that is exceedingly rare. We have a number of cases in which patients would be on the regimen for significant periods and form no stones; then they would go off it and stones would come back. *If it is so good, Dr. Spellman, why isn't it more popular?*

DR. SPELLMAN: I don't think urologists in general are convinced that it is such a good program; therefore they fail to "sell" the program to the patient. After all, there have been many programs proposed which eventually have not turned out to be effective. The patient must be sold on the idea. The diet isn't too easy to stay on. The program is constipating and, in general, is annoying. If one really wants to follow these patients carefully, one should check their urinary output of calcium and phosphorus rather frequently. Dr. Marshall had a patient who continued to form stones despite the program and normal urine values. After some detective work, he discovered that she followed the program only while she was collecting the urine specimens.

MODERATOR MARSHALL: We had one instance in which we couldn't determine why the patient continued to develop stones in spite of being on the Shorr program. The first night he was readmitted for study he asked for his milk and cream, because he was following not only the Shorr regimen but also a Sippy program for peptic ulcer. You do have to get the enthusiastic cooperation of the patient. The constipation factor can be controlled by ordinary medical means, but it can be most annoying.

The thing about the Shorr program that particularly appeals to me, is that it works in the patient who needs it most. It works in the face of alkalinizing infection. If the patient has a lot of Proteus infection you can acidify in the area around the glomerulus, but the acidity won't be adequate in the region where the stone is actually growing. In addition, in many patients low renal function will not permit the degree of acidosis obtained with an acidification program. This is not a drawback to the Shorr regimen. In fact, there might be less burden on the kidney. Accordingly, the Shorr regimen is ideal for the old chronic stone-former of phosphatic calculi who has had one stone after another with infection and disabled kidneys. It is this type of patient that the Shorr regimen works on,—indeed, works on the best. He is the patient who is scared to death and who will stay on the diet and take his gel—and bring accurate urines for checking. The diet is not bad, it is just monotonous. Also, the Basaljel is dull. One must have laboratory control, too, for the Shorr regimen. If you don't have this control you can't pick up the simple deviations from true failures. Measuring the 24-hour creatinine is important, as it is a check-up on the collection of the specimens—since the total output in 24 hours under usual conditions is about the same.

Dr. Slaughter, if a patient has stones on both sides, with one side not as good as the other, would you operate first on the good side or the bad side?

DR. SLAUGHTER: I would operate on the bad side first; I always have.

MODERATOR MARSHALL: Why?

DR. SLAUGHTER: Because you then have the better kidney to carry you through the first operation; then after the first operation you have a good kidney on the opposite side when you attack the originally better kidney.

MODERATOR MARSHALL: *In general, does the rest of the panel agree with that statement?*

DR. OPPENHEIMER: In general, I think that is true. On the other hand, I think you should individualize each particular case and not follow a rule.

MODERATOR MARSHALL: Dr. Slaughter does have a rule, however.

DR. SLAUGHTER: I have a rule.

MODERATOR MARSHALL: *Do you agree with the rule as laid down by Dr. Slaughter, Dr. Twinem?*

DR. TWINEM: I think there should be no set rule, because in general

one should operate on the better kidney first. If the better kidney has a small stone in it which may cause blockage, then I would operate on the better kidney first so that blockage would not occur postoperatively. Also, in some cases there may be a question as to whether the poorer kidney should be *removed* or not. If you operate on the better kidney first and get it into good condition, then you can readily operate on the worse kidney. You can examine it carefully and then, with more or less equanimity, decide whether the kidney should be removed or not. If you operate upon the poorer kidney first you will be less able to decide this point. I agree with Dr. Oppenheimer: each case should be individualized.

MODERATOR MARSHALL: *Here is a question from the audience: Where does urinary surface tension fit into the picture of recurrent urinary calculi?*

DR. SPELLMAN: Much of this urinary surface tension problem is beyond me. We do know that the large muco-protein molecule increases the surface tension; the smaller molecules lower it (such as the glucuronides). What this actually has to do with renal calculous formation remains to be explained. I think the answer lies in our better understanding of the collagen system and also the physiology of the mucosa itself.

MODERATOR MARSHALL: The whole subject of these colloids in the urine is relatively new and not well understood. Surface tension is probably related in some way, as yet undetermined. Dr. Harlin of Brooklyn has worked on this problem and has obtained some interesting findings, but they are all rather new and have not been evaluated.

Here is another question from the audience: Would you carry a woman through pregnancy on the Shorr regimen? I can answer that one: We have done so on several occasions and nothing untoward has happened, either to the mother or the child.

Dr. Slaughter, what do you do with a small renal infarct noted during a renal split?

DR. SLAUGHTER: I have never encountered it, but I would remove it.

MODERATOR MARSHALL: I have seen one noticeable infarct during a kidney split operation. The postoperative hemorrhage did come from that infarcted area.

Another question from the audience: How long should a patient be kept on a diet to prevent recurrence of calculi? By the use of the word

"diet" I presume the Shorr regimen is meant.

DR. SPELLMAN: I like the statement that Dr. Hess has made—that once a patient has a staghorn stone he is a urological problem for life. One certainly has to individualize cases. I think it is advisable, even after a simple nephrolithotomy, to use the program for at least six to nine months, to prevent a recurrence in the operative area. Chronic stone formers should probably follow the program indefinitely.

MODERATOR MARSHALL: Nobody knows just how long, but it had better be longer than shorter.

DR. OPPENHEIMER: Dr. Marshall, in some stone statistics 10 per cent of the total number of stones recurring, did so after 15 years.

MODERATOR MARSHALL: If you tell the patients to continue on the regimen indefinitely, you have advised them correctly although this advice as to time may possibly exceed the necessary requirement.

Here is a question about the use of the Shorr regimen in growing children. We have had so few children with phosphatic stones on the regimen that I cannot answer the question except to say that we have put young patients (five years of age) on it, and have kept them on it for many months without significant troubles. What may happen to these patients in 15 or 20 years I can't say, because we have insufficient experience. We have had patients who developed a little osteoporosis, but that's about all. After all, this is not a diet in which there is no phosphorus. The phosphorus is just moderately low.

Another question: Of what value is the determination of urinary creatinine in the stone former?

DR. TWINEM: I think the value would be little, except in cases where stone formation is very advanced and kidney function is poor.

MODERATOR MARSHALL: It might show that the patient had poor renal function.

DR. SLAUGHTER: I agree.

DR. SPELLMAN: It is a fairly constant item in the urine, thereby enabling one to tell if a full 24-hour specimen has been submitted for analysis of the calcium and phosphorus levels.

MODERATOR MARSHALL: *It appears to me like a metabolic problem. Is not the relation between creatinine and muscle partly a phosphatic problem?*

DR. EPHRAIM SHORR (from the audience): It is, if there is coincidental disease with impairment of the muscle metabolism. If the patient loses

weight, then it will fall. It was suggested some years ago that estrogens might be useful as they would increase the output of citrate and at the same time decrease the calcium output in the urine.

DR. SPELLMAN: We haven't had a clinical program to test the estrogen idea, but it does sound reasonable.

DR. TWINEM: I tried to use estrogens but most of the patients didn't like the effects.

MODERATOR MARSHALL: Women who have a uterus may well have difficulties on an estrogen program. If the urine is infected, the organisms apparently use up the citrate and it doesn't have much effect. Men usually don't like the effect of estrogens, for obvious reasons.

Another question from the floor: Has any work been done with heparin in dissolving kidney stones? Has anyone on the panel had any experience with heparin for this purpose?

PANEL: No experience.

DR. OPPENHEIMER: Has anyone on the panel had any success with Versene?

MODERATOR MARSHALL: We have used Versene several times without beneficial results. It is definitely irritating. We have had a few minor successes in dissolving soft stones, really mud, with G-solution; but we have had a minimum of success with the hard, well-formed calculus.

Dr. Twinem, will a change in climate, physical activity, or geographical location reduce the recurrences of the stone-former? In other words, is it a good idea for him to go to Florida or to some other escapist place?

DR. TWINEM: I don't believe climate will have any effect in such a case. If a person has a tendency to form stones and he goes to a very warm climate, his urine will be more concentrated. He may lose more moisture by perspiration. During the war in the Pacific area, a great many young men formed small stones in a higher proportion than they do at home, probably because of their very concentrated urine.

MODERATOR MARSHALL: Vitamin-A deficiency, Randall's plaques, small infarcts, recurrent infections, areas of fibrosis, dehydration, arteriosclerosis, stress and strain, have all been proposed at one time or another as significant causes of calculi. If these conditions play a significant role, it would seem that the incidence of stones should increase with age,—the longer one lives, the more likely would be the probability of these conditions arising and causing stone formation. Renal stones

ought to be a major cause of death in old age, but actually the incidence of first renal stones is not great at all in the later years of life. We have had one child of two years who formed idiopathic renal stones and I have seen only one person who, on clear evidence, formed the first renal phosphatic stone after the age of 65. The vast majority of first renal stones occur between 20 and 55 years of age. *Can you explain this incidence rate?*

DR. SLAUGHTER: No, that's why I have to split kidneys.

DR. TWINEM: Bladder stones do increase definitely with age. Kidney stones are more frequent in middle age.

MODERATOR MARSHALL: We are talking about kidney stones. The reason that urinary stones increase with age in men is obvious, because of the prostatic obstruction. You may have infection associated with the obstruction. I think that this shows the importance of these factors, whether it be applied to bladder or kidney. *Do you have a clear idea, Dr. Slaughter?*

DR. SLAUGHTER: I do not.

DR. OPPENHEIMER: I know nothing about stones after tonight!

MODERATOR MARSHALL: *Dr. Spellman?*

DR. SPELLMAN: No.

MODERATOR MARSHALL: I think we might end on that note, showing that there are many things we don't know about stones.

Question from the floor: *Dr. Slaughter, how many times have you done a second or third bisection on a solitary kidney?*

DR. SLAUGHTER: Never on a solitary kidney.

Question from the floor: *I would like to ask Dr. Slaughter what he does about associated lesions in the upper urinary tract in cases where he split the kidney.*

DR. SLAUGHTER: If there is any major disorder in the upper urinary tract, we repair that. We always do that at the same time.

Question from the floor: How about oxycel?

DR. SLAUGHTER: I don't like it. It is a foreign body, can cause difficulties and is unnecessary.

DR. JAMES J. TOOMEY: Unless there is an urgent question we must bring this meeting to a close. On behalf of the Section on Genito-Urinary Surgery of the Academy, I wish to thank our panel members for their interesting and stimulating discussion.