

THE UNIVERSITY OF MINNESOTA
GRADUATE SCHOOL

Report
of
Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Charles Roderick Blackburn Crompton final oral examination for the degree of Master of Science in Urology.

We recommend that the degree of Master of Science in Urology be conferred upon the candidate.

W. F. Braasch
Chairman

H. E. Robertson

B. J. Clawson

Franklin R. Wright

Date Dec. 2-1922

REPORT
of
Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Charles Roderick Blackburn Crompton for the degree of Master of Science in Urology. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science in Urology.

W. F. Prosser

K. Brodeur

Franklin R. Wright

Graduate School, University of Minnesota.

Date: November 28, 1922.

This is to certify that Charles Roderick Blackburn Crompton, a candidate for the degree of Master of Science in Urology, has passed the final written examination for the major in the Department of Urology.

W. F. Braesch

For the Major Department.

Graduate School, University of Minnesota.

Date: November 28, 1922.

This is to certify that Charles Roderick Blackburn Crompton, a candidate for the degree of Master of Science in Urology, has completed the requirements for the minor in the Department of Pathology.

A. C. Broder

For the Minor Department.

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THESIS

RESULTS OF THERAPY IN CORD BLADDER

Charles Roderick Blackburn Crompton, M.B.

Submitted to the faculty of the Graduate School of the
University of Minnesota in partial fulfillment of the
requirements for the degree of Master of Science in
Urology.

October, 1922.

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1

Nitze was the first to observe the resultant changes in the urinary bladder, and recognize their significance, in syphilis of the central nervous system. In 1901, under the direction of Nitze,¹ Hirt published the first case in literature of a trabeculated bladder in a tabetic patient. In 1907 the original observations of Nitze² and their significance are recorded in the second edition of his urologic textbook.

Since the time of Nitze much has been written on the cystoscopic findings and treatment in cord bladder in central nervous system syphilis but few observers have recorded the results of such therapy and especially the changes in the cystoscopic picture. To this latter point the major portion of this study is directed. An endeavor has also been made to clarify the varied and often complex genito-urinary symptomatology occurring in these cases. First, to determine the most characteristic and frequently occurring symptoms; second, their sequence of appearance in the disease; and third, the time of appearance in relation to the general symptomatology, in the hope that earlier diagnosis and treatment might be established before so much irreparable damage to the nervous system and urinary tract occurs. It is not my purpose to discuss this subject from a syphilitic standpoint, but primarily to show the results in urologic therapy in conjunction with adequate antisyphilitic treatment.

The basis of this study is composed of fifty-six cases of cord bladder complicating syphilis of the central nervous system, examined and treated, or patients who returned for treatment during the years 1920 and 1921 at the Mayo Clinic. All patients received complete general, cystoscopic, neurologic, and syphilologic investigation with the necessary serologic data in confirming the diagnosis, and were adequately treated from an antisyphilitic standpoint. The diagnosis of central nervous system syphilis from the bladder picture presented in cord bladder is highly suggestive but not conclusive, since, as pointed out by Strümpel⁴ cord bladders may occur in any spinal cord

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diseases involving the posterior or posterior and lateral pyramidal tracts.

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Caulk and Greditzer also observed that the bladder picture is similar in a large number of non-syphilitic, organic and presumably functional disturbances of the central nervous system. On this account great care is necessary in excluding other etiologic factors. Complete clinical investigation is necessary, therefore, in accurate diagnosis.

Of the fifty-six patients six were females and fifty males. It would appear, therefore, that cord bladders are of more frequent occurrence in the male. A history of primary syphilitic lesion was noted in 68 per cent of the males. All females gave a negative history. A history of secondary syphilitic manifestation was noted in only 19 per cent of the patients, all of whom were males. These patients also gave a positive history of a primary luetic lesion. A history of Neisserian infection was also noted in 78 per cent of the males. A negative history of a primary syphilitic lesion is of frequent occurrence and especially is this so of secondary syphilitic manifestations. A history of Neisserian infection is of more frequent occurrence.

It is of interest to note that in only 35 per cent of the cases had the diagnosis of syphilis been made elsewhere, and in not a single instance had their bladder involvement been recognized or treated. In this series cord bladder was primarily diagnosed in 16 per cent of the cases at cystoscopy, leading to the ultimate diagnosis of central nervous system syphilis when it had not been suspected during the general examination. It therefore occurs that patients whose initial or chief complaints are urinary disorders consult the urologist first, and he often has the added advantage of arriving at an earlier diagnosis. Various explanations for the occurrence of genito-urinary symptoms in the tabetic bladder have been advanced by different observers. However, the most generally accepted view is that genito-urinary symptoms result primarily from disturbances in the sensory impulses from the bladder to the brain and cord centers, resulting in incoordination of the muscles of urination, and, secondarily,

urinary infection. Since urinary infection has already occurred in the majority of cases before a diagnosis is made, symptoms that are primarily due to nerve involvement are masked by the added factor of infection.

From the histories of various departments, 91 per cent of patients complained of genito-urinary symptoms. In 46 per cent of the cases they were initial in onset; in 60 per cent they were the chief complaint; 80 per cent of cases also had urinary symptoms of subsidiary importance. On an average they were of longer duration than other symptomatology. In order of frequency of occurrence, difficulty of urination appeared as a symptom in 69 per cent of cases; incontinence in 60 per cent; decreased sexual power in 58 per cent; frequency of urination in 42 per cent; and dribbling or lack of force to the urinary stream in 39 per cent; dysuria was present in 10 per cent; urgency in 7 per cent; while loss of bladder sensibility to urinary pressure, pyuria, complete retention, infrequent urination and pain referred to the testicle occurred in two cases each. Hematuria, vesical tenesmus and nocturnal seminal emissions occurred in one case each. In regard to the relative time of occurrence of the genito-urinary symptoms during the progress of the disease, difficulty of urination had existed on an average of more than sixty-one months; frequency of urination occurred in 46 per cent, over an average of 45.8 months; incontinence of urine over an average of forty-one months, and impotence over an average of thirty-eight months, while lack of force to the urinary stream had existed over thirty months before admission to the Clinic. These, therefore, are the most characteristic and frequently occurring symptoms referable to the genito-urinary tract, and in the majority of cases develop in the above order in the course of the disease. That such a large percentage of cases of tabetic bladder had genito-urinary symptoms, and since these symptoms had been present over a period of ninety-one months before cord bladder was recognized, should be a plea for more careful attention to genito-urinary symptomatology and their investigation. By this means earlier diagnoses and the

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adoption of treatment with improved prognosis would be established in a larger percentage of cases.

It is of interest to note that on admission to the Clinic forty-nine patients gave a negative blood Wassermann reaction; in seven only (12.5 per cent) was it positive. Therefore, a negative blood Wassermann reaction in cord bladder cases complicating syphilis of the central nervous system is of most frequent occurrence, and is of little significance as an aid in diagnosis.

Antisyphilitic Therapy

Of the fifty-six patients, fifteen gave a history of arsphenamine treatment. Fourteen had taken mercury either by mouth or as inunctions before admission to the Clinic. Any improvement as the result of such medication was invariably given as slight or questionable, since it had been taken irregularly and over an insufficient period. In the administration of antisyphilitic therapy at the Clinic the general contraindications were observed and changes in treatment made according to the individual case, as for example, cessation of all treatment temporarily, or the intravenous injection of sodium iodide in conjunction with intramuscular mercury succinamide; or arsphenamine may be replaced by neo-arsphenamine and given in approximately smaller dosages; or intraspinal therapy may be given where indicated. Intravenous arsphenamine was usually given at weekly intervals, with gradually increasing dosages from .3 to .6 gms. for approximately six injections to a course. During each course daily intramuscular injections of mercury succinamide from 1/6 to 1/4 grs. were given. After the first course of treatment the patient returned home for a period of approximately four months, taking daily mercurial inunctions during the second and third months of this period. They then returned to the Clinic for further observation and treatment. All cases are hospitalized for twenty-four hours at least after each arsphenamine treatment, and during their course of therapy at the Clinic daily observation of the urine is made, and if indicated, renal function checked frequently. General

measures such as low protein salt-free diet, and diuresis are encouraged by copious intake of fluids and alkaline drinks, if renal insufficiency is in the least suspected. Attention to diet, with especial avoidance of coarse or acid foods is insisted on, and foci of infection are eliminated early in the course of therapy. ²⁵ In all cases from which the results of the combined urologic and anti-syphilitic therapy were deducted the length of treatment averaged approximately eighteen to twenty-four months. Noticeable improvement was evidenced not only in the general condition and symptomatic relief but also in the serologic data as the result of such therapy.

Urologic Therapy

In the present study of tabetic bladder particular attention was primarily paid to the exclusion of other urologic pathology that could be considered as etiologic factors in the production of the symptomatology and cystoscopic findings presented, such as hypertrophy of the prostate and stricture of the urethra or other mechanical obstruction to the lower urinary tract. ³ ⁶ Hirtz, Hirt, and Böhm were among the first to emphasize the primary importance of this fact as being most essential, especially for the early diagnosis of tabes by the cystoscopic picture presented. Since in the majority of cases of cord bladder residual urine with infection of the urinary tract is present, intermittent catheterization and lavage of the bladder was instituted in forty-four of the forty-five cases having residual urine, the frequency of catheterization and lavage depending on the quantity of residual urine and the degree of infection present. In addition to elimination of foci of infection in the tonsils, teeth and accessory sinuses, chronic infections about the vesical neck, such as prostatitis, vesiculitis and posterior urethritis were investigated and treated, since their presence serves as a possible source of upper urinary infection, especially in the presence of residual urine. Lavage of the renal pelvis was given for existing pyelonephritis, pyelitis and ureteritis if indicat-

ed, with the administration of urinary antiseptics, and general measures to stimulate elimination by the excretory organs.

In the endeavor to decrease the amount of residual urine it is important to impress on the patient that he should systematically endeavor to void at frequent intervals with the fullest concentration on the act, especially before catheterization of the bladder is attempted. In this way the function of the accessory muscles of micturition is increased which partially atones for the loss in function of those muscles already rendered atonic by the disease. Thus the gradual recovery of bladder function is favored with progressive reduction of residual urine. The above measures all serve to reduce residual urine, overcome urinary infection, thereby improving renal function. By these means, the often serious urinary complications so frequently seen in the tabetic are prevented. A more adequate antisyphilitic regime is thus permitted with an improved prognosis and greater symptomatic relief is obtained. Since it is generally known that arsenemine and mercury have especially peculiar selective affinity and injurious action on the pathologically involved renal parenchyma, measures which will preserve or improve renal function are above all indicated in conjunction with antisyphilitic therapy.

The duration of bladder lavage and intermittent catheterization in these cases both at the Clinic and at home averaged approximately eighteen months, with frequency of from one to three times daily. Lavage of the renal pelvis was given at weekly intervals for from six to eight weeks and was repeated on following visits of the patient to the Clinic if indicated. Renal function was investigated at intervals, especially where any evidence of impairment was suspected, by means of the blood urea estimation in conjunction with the combined phenolsulphonphthalein test, and general routine measures adopted as noted above.

Renal Function.

Since the combined phenolsulphonephthalein tests where urinary retention occurs are almost routinely incorrect, unless routine catheterization of the bladder is practiced at its conclusion, greater reliance was placed on the retention of non-protein nitrogen in the blood as an indication of renal function. The following blood urea readings are indicated in milligrams for each 100 c.c. of blood, in twenty-three patients on whom the combined system of therapy was performed. The highest blood urea estimation before therapy was 60 mg.; the lowest was 12 mg. The average estimation was 33.2 mg. In twenty-one patients blood urea estimations were determined after combined therapy. The highest reading was 61 mg.; the lowest 16 mg., while the average estimation in these cases was 37.6 mg. Of the nine patients receiving the combined urologic and anti-syphilitic therapy blood urea estimations were obtained before and after treatments and were as follows:

Case	1	2	3	4	5	6	7	8	9
Before therapy	24	24	45	34	36	22	50	34	30
After therapy	30	32	28	42	42	26	50	44	48

Thus, in three cases the blood urea estimations remained within normal limits; one case showed a marked reduction; one case remained the same. Four cases showed but slight increase. Therefore, under the urologic therapy in conjunction with anti-syphilitic treatment, renal function as indicated by blood urea estimations is preserved. General improvement was noted in each case. The combined phenolsulphonephthalein estimations were of diagnostic value in 35 per cent of cases as indicative of urinary retention, since the readings were disproportionately low in comparison with the blood urea findings. Of fourteen cases the average reading before combined urologic and antisiphilitic therapy was 43.57 per cent, while after the average reading was 48.21 per cent, which serves to confirm the blood urea determinations.

Residual Urine.

Of the fifty-six cases forty-five (80 per cent) were noted as having residual bladder urine during treatment at the Clinic. On admission thirty-three (59 per cent) of the patients had residual urine noted. Of these three cases had complete urinary retention. In all cases having residual urine, infection was demonstrated in the passed urine. In the thirty remaining patients residual urine varied from two to twenty ounces before therapy. Following therapy variations in residual urine from 0.5 to 30 ounces were noted. However, of fourteen cases having intermittent catheterization and lavage of the bladder in which the quantity of residual urine was noted before and after treatment, the estimations were as follows:

Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Before therapy	6	6	10	20	6	8	8	8	10	3	6	6	14	14 oz.
After therapy	4	1	3	0	1	3	32	1	13	0	3	1	17	0 oz.

In seven of these cases, therefore, residual urine decreased to practically negligible amounts, and in the remainder a noticeable decrease was noted with three exceptions. Of the three exceptions, one case had urologic treatment adopted late in the course of the disease, one case had carried out local bladder therapy irregularly, while in one case residual urine apparently persisted in spite of therapy. The relation of decreased residual urine to renal function is noted from the fact that in five cases showing a decreased residual urine under bladder catheterization and lavage, the blood urea estimations showed a marked decrease in one case; in two cases it remained within normal limits; in one it remained the same; while but a moderate increase was noted in the blood urea estimation in the remaining case. In the latter case moderate enlargement of the prostate gland was noted, but was reported nonobstructive at cystoscopic examination. Also in seven cases showing a decreased residual urine under bladder drainage and lavage, renal function as indicated by the combined phenol-sulphonaphthalein test was considerably increased in five cases, remained the same in one case, and within normal limits in the remaining case.

In three patients having complete urinary retention marked infection was present in the urine as a result. Permanent catheterization in these cases was exceptionally well tolerated with immediate symptomatic relief and improvement in the general condition. These results stand out in marked contrast to the condition frequently obtained by the sudden withdrawal of large quantities of residual urine in cases of mechanical obstruction which frequently precipitate the onset of uremia and in which gradual decompression has proved so successful. The explanation of these divergent results is undoubtedly seen from the blood urea findings in cord bladders where even with complete retention renal function may be normal. However, in cord bladders with urinary retention, marked infection and pathologic changes occur where residual urine is ignored, as shown by the accompanying plates, so that with complete retention in cord bladder where a high blood urea occurs, gradual decompression should be employed.

Urinary Infection.

According to many observers, urinary infection in syphilis of the central nervous system is above all other complications most frequent and especially to be guarded against is the occurrence of pyelonephritis. As shown by Hirt, Orth, Barney and Burns, severe pathologic changes in the upper urinary tract frequently complicate the tabetic bladder. Dilatation of the ureter is usually very pronounced when it occurs, and occasionally involves the renal pelvis and calices. Consequently whether dilatation of the upper urinary tract be primarily atonic or of an infectious origin, it is difficult to say on account of the coexistent infection ever present in these cases.

Barney concludes that fully 60 per cent of these patients die as the result of urinary tract infection. Squier also draws attention to the peculiar susceptibility of tabetics to urinary infection. In the present study of fifty-six cases, forty-nine or 87.1 per cent showed infection of the passed urine on admission to the Clinic, in thirty-four of which the urine was checked as to the

presence of infection before and after receiving bladder drainage and lavage. Before therapy all were infected. Thirty-one cases remained positive after therapy, while three became negative for infection. However, the degree of infection of the urine was also estimated by the number of pus cells in the low power field of the microscope before and after urologic therapy. By this means, of thirty-four cases under urologic therapy, nine cases retained the same degree of infection; in ten cases the infection was decreased, three of which became negative, while in fifteen cases infection was slightly increased.

22

That residual urine, as concluded by Fearnside, is of major etiologic significance in the production of urinary infection, appears conclusive for the following reasons:

In 87 per cent of the patients the urine was infected on admission to the Clinic. Residual urine was noted in 58 per cent of cases on admission, and was infected in every case; similarly, also, in 80 per cent of cases in which it was noted during therapy it was also infected in every case.

In eleven cases in which residual urine did not occur, three cases were negative for infection, seven showed an occasional pus cell in the passed urine, while in one moderate infection was present.

Also, in eleven cases which showed a decreased residual urine under bladder drainage and lavage, the degree of infection decreased in seven cases, prevented from increasing in three, while in one slight increase in infection was noted.

The incidence of urinary infection observed in this study is higher than that reported by Böhme, Gowers, Sachs, Erb, Squier, Oppenheim, Barney, and Bramwell, and is of significance, and warrants the early establishment of bladder lavage and intermittent catheter drainage in cases with residual urine whether infected or not, since they undoubtedly ultimately become so. The severity of cystitis occurring in cord bladders seems also directly dependent on

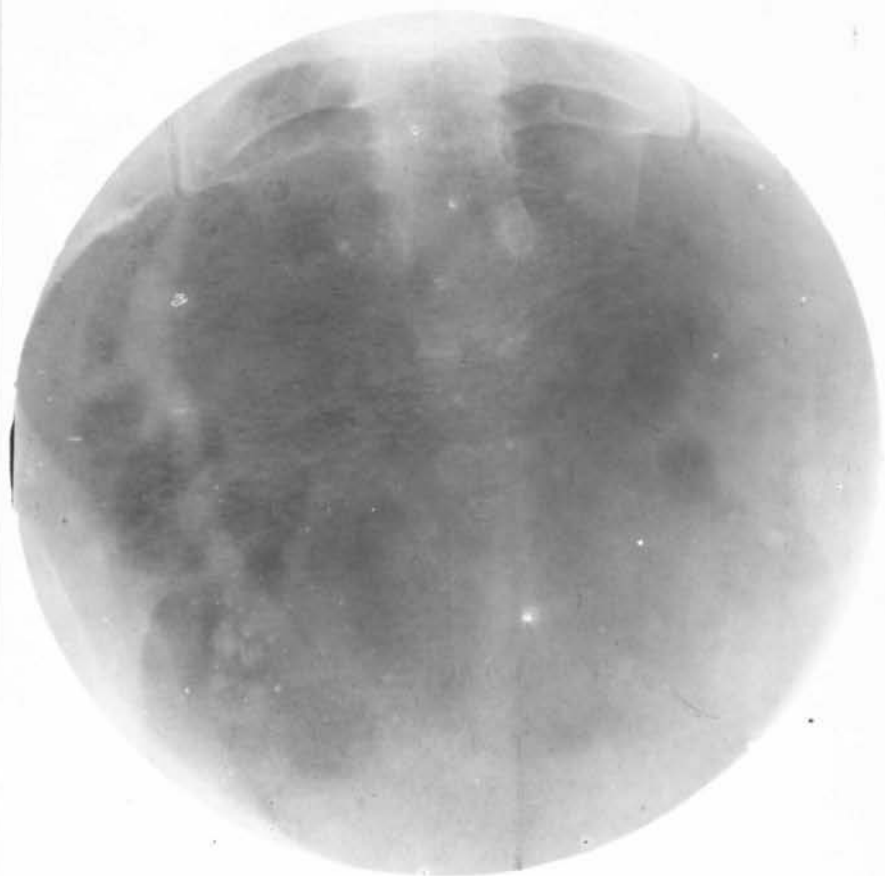
the quantity of residual bladder urine present. Cystitis occurred in thirty-two (57 per cent) of the cases. In nine cases checked cystoscopically before and after urologic treatment and in which the degree of cystitis was noted, four cases showed marked improvement, three cases remained the same, while in two cases it was apparently slightly increased. In the latter cases, however, residual urine had persisted apparently in spite of treatment in one, while in the other residual urine and infection persisted because urologic therapy had been irregularly performed by the patient.

Renal Infection.

In the present study twenty-two of fifty-six cases had one or both ureters catheterized at cystoscopic examination. Of these fourteen cases showed the presence of renal infection by ureteral catheterization. All cases of pyelonephritis had varying degrees of cystitis present cystoscopically, and all markedly infected bladder urine. In two cases in which the ureters were catheterized and infection demonstrated, one showed marked dilatation of the ureter, renal pelvis and calices by means of the pyeloureterogram (Case A223926). In the other a reflux of opaque medium had occurred up the ureters from the bladder, showing ureteral dilatation in the cystogram (Case A314835).

In two cases in which the ureters were not catheterized, one showed marked dilatation of both ureters (Case A341774) and in the other the ureteral dilatation was confined to one side only (Case A362603). In both cases the pathologic changes present were demonstrated by the reflux of opaque medium up the ureters from the bladder as evidenced in the cystogram. Both cases had marked diffuse cystitis present. Therefore, sixteen of twenty-four (66 per cent) of cases had definite evidence of upper urinary tract infection demonstrated.

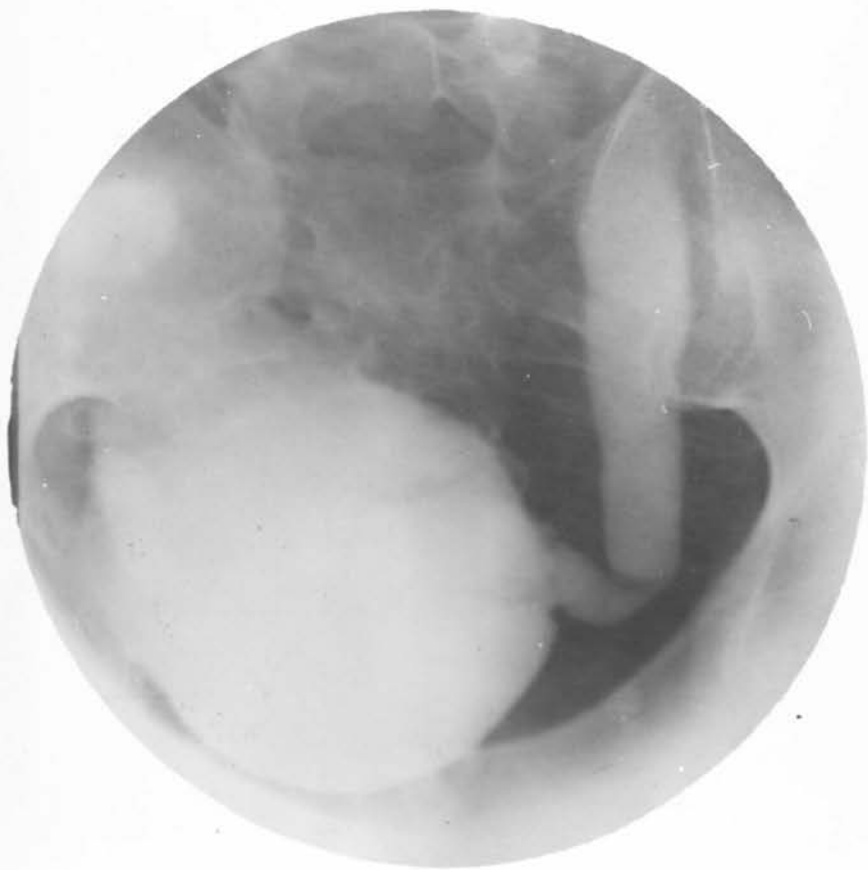
That reduction in residual urine under bladder drainage and lavage prevents or improves and does not increase the chances of renal infection is evident since in six cases having reduced residual urine under local bladder



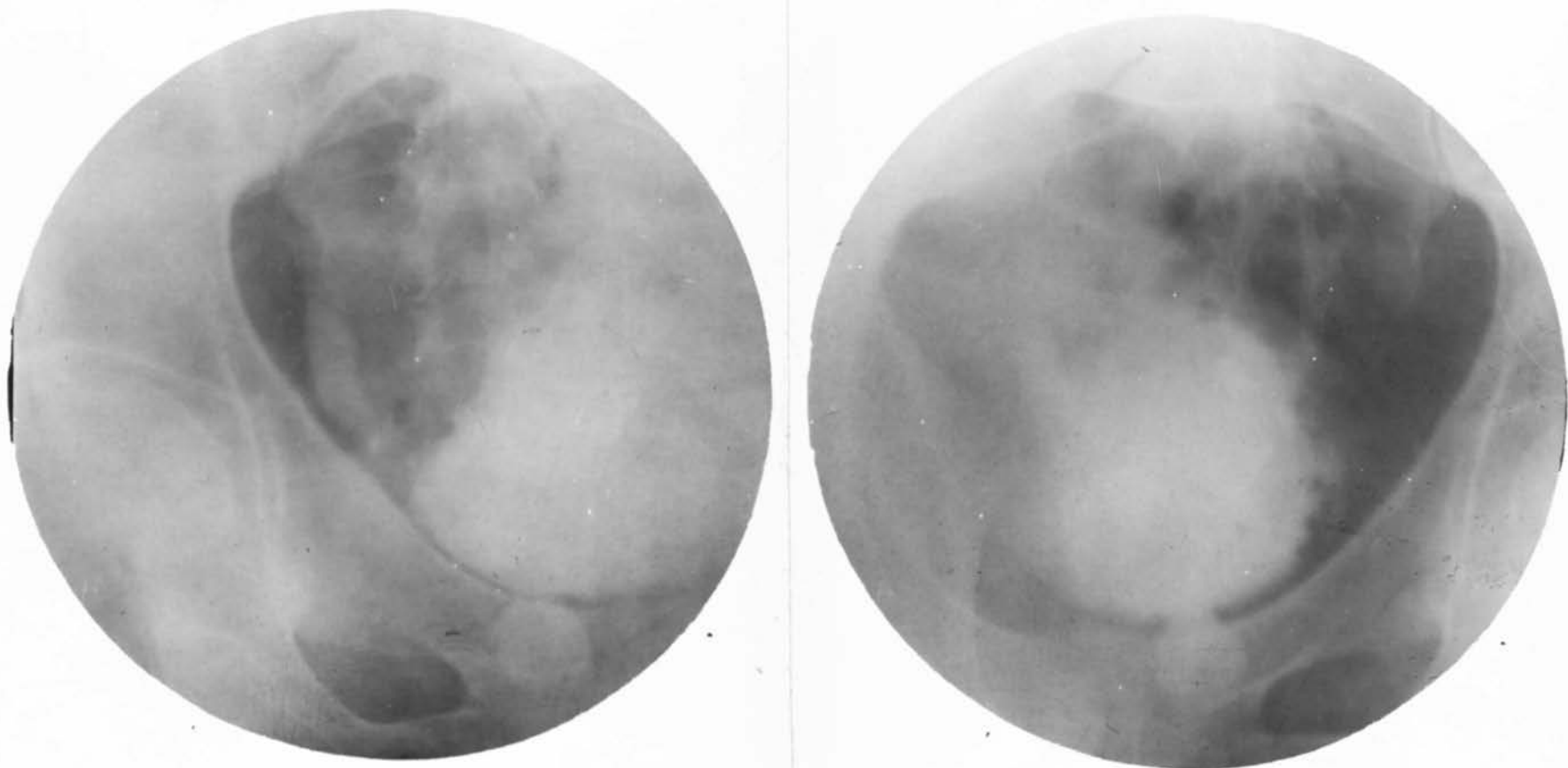
Case A223928. Right pyelo-ureterogram demonstrating marked dilatation of minor and major calyces, renal pelvis and ureter.



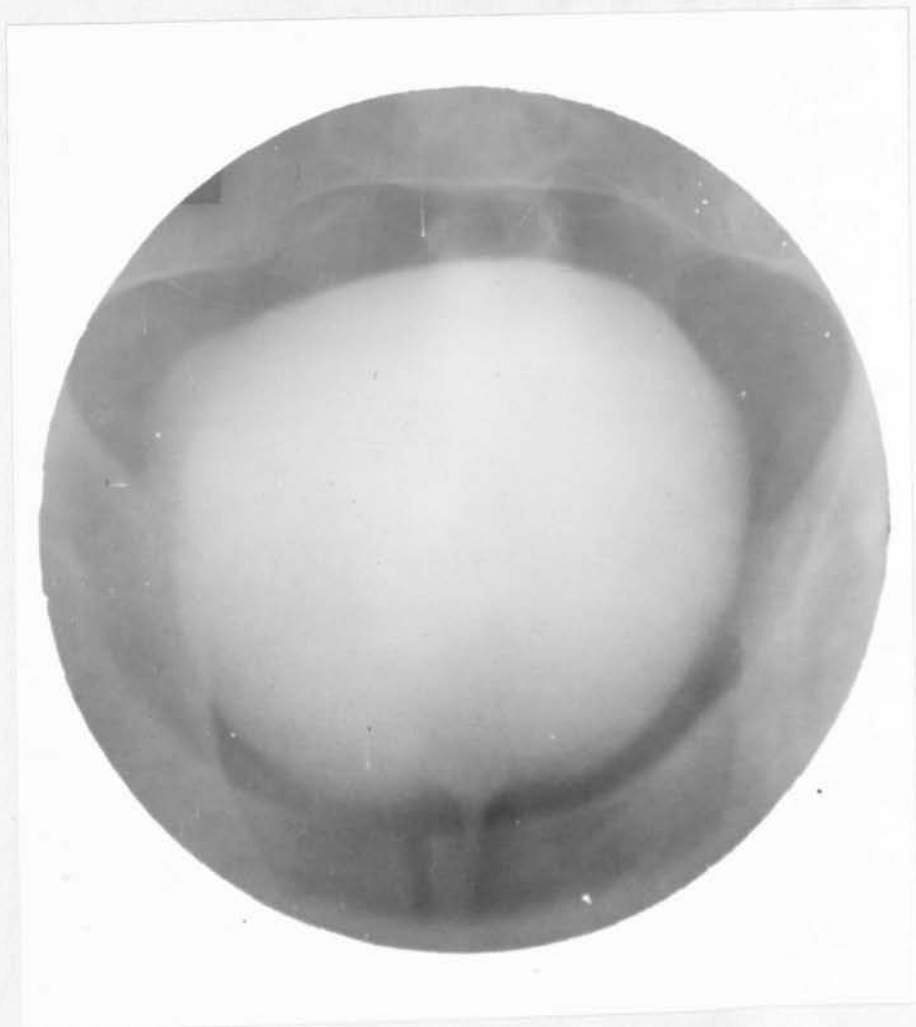
Case A314835. Cystogram(Type 1) demonstrating enlarged, elongated, distorted type of cord bladder with pronounced trabeculations and cellule formation on lateral walls and dome. Dilatation of internal sphincter and funneling of prostatic urethra.



Case A341774. Cystogram (Type 2) demonstrating the enlarged atonic type of cord bladder in syphilis of the central nervous system with slight formation of trabeculations and cellules confined chiefly to dome and lateral walls, and marked bilateral dilatation of ureters. No dilatation of sphincters evident.



Case A362603. Cystogram (Type 1) demonstrating enlarged irregular bladder outline due to trabeculations and cellular formation of lateral walls and dome. Right ureter markedly dilated. Dilatation of internal sphincter and prostatic urethra.



Case 252858. Cystogram (Type 2) demonstrating much enlarged atonic type of cord bladder. Dilatation of internal sphincter with funneling of prostatic urethra. Unusual absence of trabeculations.

therapy in which ureteral specimens of urine were obtained, none showed the presence of renal infection and the renal function remained normal. While in one case marked bilateral renal infection was present on admission (Case A223928) which responded remarkably to local bladder therapy combined with lavage of the renal pelves; when last seen this case had only slight unilateral infection present, with a normal renal function as indicated by the blood urea estimation. In marked contrast to these results are those in which renal infection and decreased renal function progress in the urologically untreated case. It is therefore logical to conclude that the absence or decrease of renal infection is directly responsible for the preservation or improvement of renal function. An intimate relation is therefore seen to exist between decrease of renal function on the one hand, and the occurrence of residual urine and lower urinary tract infection, and, finally, the insidious development of pyelonephritis on the other. These, therefore, are the important etiologic factors in reduced renal activity in the tabetic bladder.

It can be concluded, therefore, that preservation or improvement of renal function in cord bladder complicating syphilis of the central nervous system depends on our ability to combat infection of the urinary tract, and especially the occurrence of pyelonephritis by the reduction of residual urine. In this systematic intermittent bladder catheterization and lavage of the bladder, with lavage of the renal pelvis if indicated, has proved most successful, combined with adequate antisyphilitic regime.

Cystoscopic Findings.

The contour of the bladder in these cases from cystoscopic observation and as evidenced from roentgenograms of the bladder filled with an opaque medium presented two general types.

In Type 1, the most frequently occurring, the bladder is seen to be large and distinctly trabeculated. It is often vertically elongated and

distorted with irregular walls due to the presence of numerous cellules and characteristic trabeculations. The trabeculations are seen to involve, as pointed out by Böhm⁶, chiefly the lateral walls and dome.

In Type 2, the bladder was usually seen to be of larger capacity with marked atony of its walls. The trabeculations and cellule formation, if at all present, was noticeably less distinct and disappeared readily on distension of the bladder with fluid injected through the cystoscope.

These two general types of cord bladder complicating syphilis of the central nervous system showed varying degrees of relaxation of the internal sphincter, described by Caulk and Greditzer.¹⁵ The external sphincter also showed relaxation frequently, but always to a less or equal degree than that of the internal sphincter. The small contracted tabetic bladder with complete relaxation of both vesical sphincters was not noted in this study.

In Type 1 bladder, an unusual contractibility or spasm of the detrusor musculature was noted in one case, associated with an apparent hyperaesthesia of the vesical mucosa. On this account practically a normal force to the urinary stream was apparent through the cystoscope. This peculiar hyperirritability has been explained by Walker,¹⁶ Barney,¹² Smith,²⁶ and others as possibly similar to the hyperaesthesias seen in peripheral nerve lesions, or due to the severe accompanying cystitis as noted in normal bladders by Nogues.¹⁷

The atonic or Type 2 bladder was noted as occurring in thirteen of the fifty-six cases.

The ureteral orifices were also noted as atonic and gaping in nine cases, with sluggish or absent contractions as described by Koll¹⁸ or as fixed and rigid as noted by Greenberg.¹⁹ Severe bladder ulcerations were noted in one case that could possibly have been of trophic origin as suggested by Orth.¹³

Chronic posterior urethritis and prostatitis was noted in five cases that necessitated treatment. Increased vascularity of the trigone and

interureteric ridge as noted by Walker and Koll was not noted in this study.

The size of the bladder as in types 1 and 2 is frequently seen to be enlarged. This was noted in sixteen cases on cystoscopy before therapy. On bladder drainage and lavage of cases checked cystoscopically the size of the bladder decreased to normal or remained normal in every case. It seems apparent, therefore, that the size of the bladder and tone of its musculature returns to normal more readily under bladder drainage and lavage. This stands out in marked contrast to results seen in cases where residual urine persists from irregular or neglected urologic therapy.

Trabeculations.

¹ Nitze observed trabeculations of the bladder in many cases of tabes dorsalis when no other sign or symptom of the disease was present. In 1901 ³ Hirt described the character of tabetic trabeculations as "net formed" and noted them converging toward the bladder orifice in certain cases. Böhm observed them to be of greatest delicacy and regularity and pointed out their characteristic distribution in the bladder which ¹² Barney confirmed in 80 per cent of his cases. Walker also reported cases of unilateral trabeculations while ⁵ Caulk and Greditzer described them as fanning out laterally from the ureteral orifices. Various theories as to the etiology of trabecular formation in cord bladders have been advanced, but that they are genuine localized hypertrophy of the bladder musculature, as ³ Hirt demonstrated by microscopic section, all are agreed. Many believe them to be primarily hypertrophic, however, while others suggest that they are primarily atonic in origin with the gradual development of secondary hypertrophic changes.

In this study fifty-three of the fifty-six (95 per cent) patients were noted as having trabeculations of the bladder whether before, during or after therapy. In thirteen cases they were noted as of slight degree; in twenty-five as moderate; in eleven as marked; and in four as extreme. In two cases there

was a peculiar absence of trabeculations. The majority of cases, therefore, have trabeculations present of slight or moderate degree, and usually do not show the deep cellule formation and prominent type of trabeculations seen in cases of mechanical obstruction. The trabeculations were almost without exception of the fine, fibrillary, ridge-like type, involving chiefly the lateral walls and dome of the bladder.

Of eleven cases in which the degree of trabeculation was noted before and after therapy, the trabeculations retained their original prominence in seven. In three cases they were noticeably less distinct; and in one they appeared slightly more prominent. That trabeculations are due to primary muscular hypertrophy from mechanical obstruction, from spasm of the external vesical sphincter, seems improbable, since in no case was it noted that increased tone or sphincter spasm was present, the cystoscope being introduced more readily than normally.

Since trabeculations occurred in 95 per cent of cord bladders of the characteristic type, their occurrence is of the greatest significance in the diagnosis. As pointed out by Nitze,² Hirt³ and Böhme,⁶ their greatest value is in the early diagnosis of tabes before symptoms or signs elsewhere develop. Atonic, nontrabeculated cord bladders do occur as the result of syphilis of the central nervous system, but since other characteristic bladder signs are usually present, diagnosis is not difficult on cystoscopy. Trabeculations in the tabetic bladder, therefore, tend to become less distinct or remain the same under urologic and antisyphilitic treatment.

Relaxation of the internal vesical sphincter in cord bladders was noted in the records of the Mayo Clinic by Braasch as far back as 1910. In the present study 93 per cent of the patients had varying degrees of internal sphincter relaxation present.

In eight cases receiving combined urologic and antisyphilitic

therapy the degree of internal relaxation was noted before and after therapy. In six cases a noticeable increase in function of this muscle was noted, and of these, two showed a complete return to normal function where previously marked relaxation was present. In two cases relaxation remained the same, while none showed increased relaxation.

Relaxation of the internal vesical sphincter muscle is, therefore, of great diagnostic value in the diagnosis of cord bladder in syphilis of the central nervous system. An increase in function of this muscle does occur and may return to normal under combined treatment.

Relaxation of the external vesical sphincter muscle was noted in fourteen of fifty-six patients (25 per cent). In all of these cases relaxation of the internal sphincter was also present to an equal or greater degree. The external sphincter was noted before therapy as slightly relaxed in five cases, moderately in six cases, and as marked in three cases. Complete external sphincter relaxation was not noted. Of the fourteen cases showing external sphincter relaxation and complaining of incontinence, nine cases had noticeable improvement of incontinence. Therefore, it seems most probable that external sphincter function is also improved. Of the fourteen cases showing both internal and external sphincter relaxation, an equal degree of involvement was noted in eight cases; in six cases the degree of internal sphincter relaxation was greater. That internal vesical sphincter involvement in cord bladder is present in advance, and always to a greater or equal degree than the external sphincter, is evident. Improvement in function of the vesical sphincters occurs with symptomatic relief under combined therapy.

Decreased sensibility of the tabetic bladder was first observed by Nitze¹ and later reported by Hirt.³ They noted that as well as the loss of sense to urinary pressure, cystoscopy and catheterization was strikingly insensitive. 16
This fact is undoubtedly the usual occurrence but Walker reports cases with

unusual hypersensibility to cystoscopy. In the present study only one case was noted as being hypersensitive to cystoscopy and with it was associated a peculiar spasm of the detrusor musculature. Of the fifty-six cases 86 per cent had decreased bladder and posterior urethral sensation and in many cases distension of the bladder with abnormally large amounts of fluid was possible without pain.

In seven cases receiving combined treatment, the degree of vesical sensation was checked before and after therapy. In two cases sensation was markedly improved; in three it remained apparently unchanged; and in two it was apparently decreased. Therefore, in five of the seven cases the gradual decrease in bladder and urethral sense seen in the untreated tabetic patient was improved or remained the same under combined urologic and antisyphilitic treatment. That increased sensibility of the bladder occurs under the combined system of therapy is of great importance to the patient, since bladder sensibility is intimately associated in the initiation of the normal urinary reflux.

Hypertrophy of the prostate was noted in 5 per cent of cases in this series, but as Braasch had noted, owing to the relaxation of the muscles of the pelvic floor and periprostatic tissue, the potentially obstructing enlarged gland was non-obstructing in all cases. This point is amply demonstrated as seen through the direct vision cystoscope; by the injection of fluid the enlarged prostatic lobes are readily displaced laterally. Surgical intervention in hypertrophied prostate complicating cord bladders should be undertaken with great care, and, as Judd and Braasch point out, the demonstration of a normal functioning external sphincter is of prime importance. They report successful results with symptomatic relief following prostatectomy in cord bladder cases. Young observed similar results in his cases.

Improvement in General Health.

In thirty-nine cases in which urologic therapy was systematically and conscientiously performed by the patient under the combined system of ther-

apy, noticeable improvement in the general condition of the patient occurred. In many cases improvement was striking and immediately seen, from the renewed sense of mental and physical well-being of the patient, by the disappearance of pallor and generalized inertia, and by the elimination of the distressing urinary symptoms. Since the symptomatic relief, preservation of renal function and improvement in the patient's general condition, obtained by systematic urologic treatment directed against the etiologic factors of renal damage, allow of a more efficient antisyphilitic therapy, I felt that this study was warranted.

Conclusions.

In central nervous system syphilis, 91 per cent of cases had genito-urinary symptoms before a diagnosis of cord bladder was made. In 60 per cent of cases they were the chief complaint; in 46 per cent of cases they were the initial symptoms. An earlier diagnosis was primarily made possible in 16 per cent of cases by the cystoscopic picture presented. On an average, genito-urinary symptoms are of longer duration than other symptomatology. The most characteristic symptoms referable to the genito-urinary tract in order of frequency were difficulty, incontinence, impotence, increased frequency, and lack of force. Therefore, more careful consideration of genito-urinary symptomatology and urologic investigation will materially facilitate earlier diagnosis.

Under combined urologic and antisyphilitic therapy (1) the size of the bladder remains normal or is decreased to normal as observed cystoscopically; (2) trabeculations, occurring in 95 per cent of cases, tend to become less pronounced; (3) internal sphincter relaxation, occurring in 93 per cent of cases, disappears or improves or remains the same; in no case did relaxation increase; (4) external sphincter relaxation occurred in 25 per cent of cases; its function was improved as seen from improvement of incontinence in nine of fourteen cases; (5) decreased bladder sensation occurring in 86 per cent of cases, under therapy is frequently increased or sustained. All of these changes are strong evidence

of a return of normal bladder function with marked symptomatic relief.

Residual bladder urine occurred in 80 per cent of cord bladders and was infected in every case. In cases in which residual urine did not occur, infection was absent or negligible. In approximately 80 per cent of cases urinary infection is present in significant degrees before cord bladder is recognized. In urologically untreated cases renal infection occurred in about two-thirds of the cases and frequently showed grave lesions of the urinary tract as seen in the accompanying plates. In every case where renal infection was not demonstrated, renal function remained normal.

Under systematic urologic therapy residual urine was materially reduced in practically every case, preventing and diminishing infection of the urinary tract and especially the occurrence of pyelonephritis, preserving renal function.

Residual urine is, therefore, the major etiologic factor in the production of lower urinary infection and subsequent renal infection, the prime factor in the reduction of kidney function.

It can be concluded that preservation or improvement of renal function in cord bladders complicating syphilis of the central nervous system depends on our ability to reduce residual urine, combat urinary infection, and especially the occurrence of pyelonephritis. In this systematic intermittent catheter drainage and lavage, with lavage of the renal pelvis if indicated, have proved most successful combined with adequate antisyphilitic treatment.

Of forty-four patients receiving combined urologic and anti-syphilitic therapy, thirty-nine showed improvement in general condition and symptomatic relief.

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