An Arris and Gale Lecture

ON

THE FUNCTION OF THE KIDNEYS
IN ENLARGEMENT OF THE
PROSTATE GLAND.DELIVERED BEFORE THE ROYAL COLLEGE OF SURGEONS
OF ENGLAND.

BY

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THE operation of prostatectomy for simple enlargement of the prostate has attained an established position in the treatment of this disease. It is attended in many cases with the most satisfactory results, but a study of the published statistics of the operation, of the results painted as they are in such rosy colours, might lead one to suppose that any man suffering from this affection could undoubtedly be cured, and cured completely, by an operation entailing little risk, a minimum of discomfort, and no troublesome sequelae.

But this is not a very accurate presentation of the facts. It is true that Sir Peter Freyer has been able to publish results showing, in the latest series of cases, a mortality of 3 per cent. In a very interesting and comprehensive review on the subject of prostatectomy which appeared recently it is stated that experience leads to the conclusion that to reach the success attained by Freyer there must be the most rigid selection of cases. Outside of the select cases complications arise which induce a mortality of 15 to 25 per cent. Surgeons of experience in this operation will agree with these statements. It is clear that to obtain a low mortality—not altogether the most desirable object of the surgeon—the possible benefits of the operation must be withheld from a considerable number of sufferers. Particularly favourable results can be obtained in patients who are almost entirely above the hospital class; such patients, usually educated men, seek advice—and good advice—at an earlier stage of the disease; they have more courage to face the problem which presents itself, and they are therefore operated upon at an earlier stage than the average hospital patient. The bladder is less frequently infected, and they do not so commonly suffer from impaired renal function.

PROPORTION OF OPERABLE CASES.

It is extremely difficult to ascertain what proportion of sufferers from enlarged prostate requiring relief are submitted to prostatectomy; no figures on this point are available. Steiner says he operated on 70 out of 180 cases he had seen. Inquiry from a good many surgeons reveals some discrepancies. Most agree that a considerable proportion are unsuited for prostatectomy. I am not able to give my actual figures, but I think I operate upon about 75 per cent. of my cases. I find the percentage of cases on which I do the operation is rising fairly rapidly.

This low proportion of operable cases is mostly among hospital patients, and it is particularly among these patients that the operation is so necessary. If catheter life is resorted to in the case of a wealthy, leisured, and educated man, the utmost precautions and the greatest care are necessary if an early disaster from infection is to be avoided. In the case of an elderly working man it is practically impossible to carry out regular catheterization with success. Only too frequently, however, when he presents himself for treatment he is found to be suffering from some complication which either precludes the operation or renders it extremely dangerous.

COMPLICATIONS OF PROSTATIC ENLARGEMENT.

The complications which deny these patients the possible benefits of prostatectomy may be considered under the following four headings:

1. Cases of Impaired Renal Function due to Back Pressure without Infection of the Urinary Tract.

These cases (Cases 1 and 2) are not at all uncommon in educated men, but are rarely met with in the hospital class. The patients present themselves with a markedly distended bladder, perhaps with complete retention, or

merely complaining of increased frequency. They are not infrequently anaemic, the tongue is dry, and they complain of headache, thirst, and sometimes vomiting. The urine is of low specific gravity, the urea percentage is low, and there is generally some albumin present without pus or organisms. Culture is sterile. If submitted to prostatectomy they almost invariably die from uraemia. Thomson Walker says: "There is no more dangerous class of case in urinary surgery." Examination of the organs in such cases reveals dilated and tortuous ureters with patent orifices, dilated pelvis and calyces in the kidneys, and thinning and fibrosis of the kidney tissue. Such cases are rarely met with among hospital patients because they have usually been catheterized and infected.

These cases are very deceptive. The slowly progressing enlargement of the prostate causing back pressure and impaired renal function may cause very little in the way of local symptoms, possibly only some frequency without pain, haemorrhage, or retention. The careful surgeon in such a case is apt to decline prostatectomy. Catheter life is started, and sooner or later—usually sooner than later—infection occurs and the patient dies rapidly.

2. Cases of Infection of the Urinary Tract.

The infection may be limited to the bladder or may have extended upwards to the kidneys, producing a greater or lesser degree of pyelonephritis. Minet describes renal infections in these cases under three headings:

1. Pyelonephritis of moderate degree. Cases characterized by a moderate degree of chronic pyuria, without fever, without signs of toxæmia, and without notable alterations in the chemical composition of the urine. In these cases there is no impairment of renal function, and they are suitable for prostatectomy.

2. Pyelonephritis of moderate degree with exacerbations, chronic pyuria with recurring attacks of fever, toxæmia, haematuria, etc.

3. Infection with Definite Impairment of Renal Function.

Minet's last class comes under this head. In these cases the impaired renal function is the result of a series of exacerbations over a more or less lengthy period. In these cases the kidneys are both distended and infected—distended on account of ureteral obstruction by distension, lengthening, and kinking of the ureter, or by swelling of the mucosa and thickening of its walls. This condition of septic renal retention is evidenced clinically by fever, renal pain, and enlargement and tenderness of the kidneys, and is usually fatal.

4. General Organic Disease.

I do not propose to consider here the difficulties caused by serious organic disease in other parts of the body.

The principal reason for the rejection of cases and for the failure of the operation is impairment of renal function associated or not with infection. The degree of impairment of renal function may be estimated by various methods, first by clinical signs alone. There can be no doubt that the very astute clinician can, without any elaborate investigation, form a very good opinion as to the suitability of a given case of enlarged prostate for operative treatment. The appearance of the patient, the presence or absence of anaemia, the state of his tongue and appetite, consideration of the temperature, sleep, pain, etc., are all valuable guides. Examination of the urine is very important: the specific gravity, quantity, urea percentage, presence of albumin, etc., must be taken into consideration. But it is clear that the clinical state of the patient is not a sufficiently accurate guide to the functional capacity of his kidneys. Some form of more direct investigation is required.

The tests elaborated and used during the last twenty years for the estimation of the functional capacity of the kidneys are very numerous. I propose to confine myself to the consideration of those tests which have been used in cases of enlarged prostate.

The Indigo-Carmine Test.—20 c.cm. of a 0.4 per cent. solution of indigo-carmine is injected intramuscularly. The dye should appear in the urine in five to ten minutes and the greatest concentration should be reached in about thirty to forty minutes. Thomas relies largely on this test. He compares the quantity of indigo-carmine excreted during the first hour with that excreted during the third hour. He regards this index of the greatest value. I use the indigo-carmine as a routine in

ordinary cystoscopic work and have also employed it extensively in cases of enlarged prostate, but it has been abandoned for reasons I will give later.

The Phenol-sulphone-phthalein Test (Rowntree and Geraghty).—6 mg. of the dye in solution of 1 c.cm. is injected intramuscularly and the urine collected by catheter. The urine is alkalinized by the addition of a solution of sodium hydrate (25 per cent.) and the time of appearance of a pink tinge is noted. This should appear in about five minutes; 50 per cent. of the dye injected should be excreted in the first hour.

Young relies largely on this test. He says if the time of appearance of the dye is over fifteen minutes, and the amount excreted during the first hour is less than 30 per cent., preliminary treatment is necessary before prostatectomy can be safely done. Bentley Squire and Victor C. Myers believe the test to be reliable when proper precautions are taken to secure an accurate collection of urine by the catheter, but in another paper Bentley Squire says occasionally a patient who has responded in an adequate degree to the phenol-red test, and would appear to be a suitable case for prostatectomy, has, after operation, developed fatal acute suppression of urine.

This test is easy to carry out with a Duboscq colorimeter, and can be done in the ward. At one time I used it extensively, and thought that it would solve many difficulties. But there are very many fallacies. In the first place the presence of even a small quantity of blood renders the test useless. The presence of pus in any but minute quantities is a great handicap. When the urine is high-coloured it is not infrequently extremely difficult to match the urine under test with the standard solution. Another great drawback occurs in cases where a preliminary cystotomy has been done. It is here almost impossible to be absolutely certain of collecting every drop of urine secreted during the first hour. It is easy enough in those cases where a small catheter has been sutured into the bladder, but when a drain of any size has been used on account of a severe cystitis or haemorrhage then the test is unreliable. This difficulty in collecting all the urine after preliminary cystotomy has led us to abandon the indigo-carmin test and the phenol-sulphone-phthalein test.

Ambard's Constant.—This method of comparing the quantity of urea in the urine with the quantity in the blood stream we owe to Ambard.

An extremely complicated method, possessing the drawback, from our point of view, of requiring the accurate collection of all the urine during one hour. This renders this test unapplicable to many cases in which a preliminary cystotomy has been done. We have not employed it.

Urea Concentration in the Blood.

This is the method of estimating renal function upon which we are now placing most reliance. I have had the good fortune to be associated in this work with Dr. William MacAdam, Lecturer in Pathology in the University of Leeds. Dr. MacAdam has carried out the blood examinations in all my cases, and I am deeply indebted to him. He will publish at a later date, and in full, the results of his investigations on the subject of impaired renal function in enlargement of the prostate and other affections of the urinary tract. I hope to be able to prove to you that this method of investigation forms a reliable guide to the condition of the kidneys, and enables the surgeon to select with success those cases suitable for prostatectomy.

The normal concentration of urea nitrogen in the blood varies in individuals. Hammett states that the urea nitrogen varies from 9.7 to 25.1 mg. per 100 c.cm., and that the average is 17.1 mg. per 100 c.cm. Dr. MacAdam, as a result of very numerous tests, regards the upper limit of variability in the normal individual as between 15 and 25 mg. per 100 c.cm.

Observations on the urea concentration in the blood in cases of enlargement of the prostate have been made by various observers.

Bentley Squire and Myers regard the normal blood content of urea nitrogen as 12.15 mg. per 100 c.cm. They think that figures over 20 mg. per 100 c.cm. in patients on the restricted protein diet of hospital suggest impaired renal function. They estimated the blood urea nitrogen in 53 cases of enlargement of the prostate. Of these 53 cases 39 recovered and 14 died. In the 39 cases of recovery the blood urea nitrogen averaged 19.6 mg. per 100 c.cm. In the 14 fatal cases the average blood urea nitrogen was 24.4 mg. per 100 c.cm. In 3 cases in which operation was contraindicated, all of which died—2 from

uraemia and 1 from diabetic coma—the examination of the blood revealed:

Case 1	...	...	Blood urea, 24 mg. per 100 c.cm.
Case 2	...	...	33 " "
Case 3 (first observation)	...	...	87 " "
(second observation)	...	...	104 " "

They conclude that the blood urea test is the most valuable pre-operative prognostic test; that cases showing urea nitrogen figures under 20 mg. per 100 c.cm. are good operative risks so far as the kidneys are concerned. When the figures are between 20 and 30, particularly between 25 and 30, the patient should receive a preliminary treatment. When the urea nitrogen figures are over 30 the operative prognosis is bad.

As part of an elaborate and most instructive investigation on the value of Ambard's constant, Kospiro Nakagawa estimated the blood urea in 12 cases of enlarged prostate in which prostatectomy was performed by Mr. Thomson Walker. The average of 11 cases successfully operated upon was 33.2, while the figure in the one fatal case was 54.2.

Two-stage Operation: Preliminary Cystotomy.

We have used this test principally in those cases where a preliminary cystotomy has been done after consideration of the figures. I am able to give the extreme value of the two-stage operation in cases where there is any impairment of renal function. I have performed the two-stage operation in these cases for many years, particularly in hospital, and I am able to give the blood urea figures in those cases in which it was done during the last year.

The advantages of the two-stage operation are many. The preliminary cystotomy is done under local anaesthesia and the time of the second operation under general anaesthesia is much shortened. During the first stage any calculi can be removed; cystitis can be controlled by drainage and treatment of the bladder; the back pressure on the kidneys is relieved, and the patient is able to get sleep. The general condition of the poisoned and uraemic patient usually changes very materially after cystotomy. The appetite improves, the tongue cleans, thirst and headache disappear, and the patient is in an infinitely better position to stand the removal of the prostate.

According to Lilienthal the relief to renal back pressure is indicated by the fact that the ureter orifices, found during the preliminary cystotomy to be patent and dilated, after a period of drainage may be found contracted. I have noticed this in several cases. There can be no doubt that the risk of a post-operative ascending renal infection is much lessened when contraction of the ureter orifices occurs.

The advantages of the two-stage operation in suitable cases have been pointed out by numerous writers, notably Kummel, Wiener, Carlier, Lilienthal, etc., and it has been widely practised. Wiener advocates the two-stage operation as a routine operation in all cases of enlargement of the prostate. He considers it is impossible to determine beforehand which cases are good operative risks, and the possible benefits of a period of drainage of the bladder should be extended to every patient.

There are some dangers in preliminary cystotomy. Peacock has found a rapid fall in blood pressure with a period of diminished reaction of urine and the appearance of albumin and casts in the urine, and Pilcher has also drawn attention to the period of renal depression. But these changes may occur after any method of emptying the bladder, particularly if it is completely emptied at one stage. There are other disadvantages. Freyer is opposed to the method for the reason, as he says, that it delays the radical operation and renders it more difficult to enucleate the tumour owing to the induration of the suprapubic wound. These are certainly disadvantages, and it is not necessary to adopt this two-stage operation in the majority of patients, particularly those above the hospital class. But there can be no doubt that many more cases can be safely operated upon by the two-stage method, and that in cases with marked impairment of renal function and with gross infection of the bladder and kidneys, it is infinitely to be preferred to the operation in one stage.

The figures presented in the following cases are the result of Dr. MacAdam's investigations. In every case duplicate observations have been made and in most cases the observer was entirely ignorant of the clinical state of the patient at the time of the first examination. In almost all these cases McLean's urea elimination test was also carried out. Dr. MacAdam will give his findings at a later date, but as this test requires the collection of all the urine passed during a given period it, like the indigo-

carmine and phenol-sulphone-phthalein tests, is not suitable for those cases where a preliminary cystotomy has been done.

Uninfected Cases.

Case 1.—G. H. S., aged 59. This patient was an example of the class of case referred to where the symptoms are very slight, the patient gradually progressing towards a state of uraemia almost without knowledge of serious bladder difficulty. When first seen he was extremely ill, with a distended bladder, vomiting, a dry tongue, headache, and thirst. He was obviously on the borderline of uraemia.

February 10th, 1920.—Suprapubic cystotomy under local anaesthetic. Urine sterile.

February 12th.—Blood urea nitrogen, 39 mg. per 100 c.cm.

February 22nd.—Blood urea nitrogen, 19.6 mg. per 100 c.cm.

February 24th.—Prostatectomy.

Coincident with the fall in the blood urea his general condition improved markedly and prostatectomy was successfully performed on February 24th, 1920. He remains well and has no symptoms of impaired renal function.

Case 2.—W. A., aged 56. This patient was in a very similar condition to the first case. He had been troubled with irritability for some time and the bladder had gradually become greatly distended. He was in great pain, vomiting, dry tongue, headache, etc. Urine free from pus cells.

February 3rd, 1920.—Blood urea, 137 mg. per 100 c.cm. Cystotomy under local anaesthesia.

February 12th.—Blood urea, 60 mg. per 100 c.cm.

February 24th.—Blood urea, 30 mg. per 100 c.cm.

March 2nd.—Blood urea, 28 mg. per 100 c.cm.

March 4th.—Prostatectomy.

March 19th.—Blood urea, 16.8 mg. per 100 c.cm.

In this case there was a remarkable diminution in the blood urea after cystotomy coincident with as remarkable a change in his general condition. Prostatectomy was successfully performed. It may be noted that the blood urea diminished after the prostate was removed.

Case 3.—W. S., aged 65, was suffering from advanced organic disease of the heart, with oedema, shortness of breath, etc. The bladder was distended, he was in great pain, vomiting, dry tongue, etc. The urine was free from pus. Catheterization was very painful and difficult. A tied-in catheter was constantly coming out and suprapubic drainage was eventually established.

September 17th, 1920.—Blood urea, 72 mg. per 100 c.cm.

September 23rd.—Cystotomy.

October 7th.—Blood urea, 22.4 mg. per 100 c.cm.

In this case the patient was immensely relieved by cystotomy, and a marked fall in blood urea concentration occurred. Prostatectomy was contraindicated by the general condition of the patient. A permanent suprapubic drainage apparatus was fitted.

No other uninfected cases during last year were submitted to the two-stage operation.

Infected Cases.

Case 4.—J. G., aged 79, was admitted with retention. Temperature 100°, pulse rising to 130, great pain; bladder very badly infected.

March 24th, 1920.—Urine contained pus and blood. Urea, 1 per cent. Blood urea, 72 mg. per 100 c.cm.

March 25th.—Cystotomy.

March 31st.—Blood urea, 14 mg. per 100 c.cm.

April 6th.—Blood urea, 11.2 mg. per 100 c.cm.

April 25th.—Prostatectomy.

June 9th.—Blood urea, 14 mg. per 100 c.cm.

This patient made a complete but somewhat slow recovery, complete cicatrization of the wound being delayed.

Case 5.—W. G., aged 69, had suffered for some years from frequency of micturition. Retention had occurred. Catheterization was very difficult, and the bladder had been tapped. Urine had leaked through the puncture. Urine contained a quantity of pus and was offensive.

June 30th, 1920.—Blood urea, 35.5 mg. per 100 c.cm. Cystotomy.

July 9th.—Blood urea, 28.0 mg. per 100 c.cm.

July 19th.—Blood urea, 25.1 mg. per 100 c.cm.

July 23rd.—Prostatectomy.

The patient made a perfectly satisfactory recovery.

Case 6.—S. C., aged 57, had some urinary difficulty for more than a year. Ten months ago he catheterized himself, and ever since the urine has been turbid and contained a deposit. He has agonizing pain on micturition. Residual urine, 6 oz.; urine containing blood and pus, and is offensive. Temperature, 102°; dry tongue; tenderness over bladder; kidneys tender.

July 21st, 1920.—Blood urea, 32.8 mg. per 100 c.cm.

July 22nd.—Cystotomy.

July 24th.—Blood urea, 28 mg. per 100 c.cm.

August 26th.—Prostatectomy.

The patient made a satisfactory recovery.

Case 7.—H. W., aged 56, admitted with cystitis, distended bladder, dry tongue, no appetite, great frequency. Urine contained a quantity of pus. Temperature 100°.

April 29th, 1920.—Blood urea, 45 mg. per 100 c.cm. Cystotomy.

May 13th.—Blood urea, 27.4 mg. per 100 c.cm.

May 17th.—Prostatectomy.

The patient made a rapid and satisfactory recovery.

The following is an example of a grossly infected case without impaired renal function.

Case 8.—G. S. B., aged 68, had suffered from serious symptoms for a long time. Had been catheterized. Bladder badly infected. Urine contained large quantity of pus and was offensive. Patient in great pain but tongue not dry.

April 18th, 1920.—Blood urea, 15.8 mg. per 100 c.cm. Cystotomy.

April 29th.—Prostatectomy.

Rapid recovery.

The next case is an example of the result of prostatectomy in a patient where the blood urea remained high after cystotomy.

Case 9.—J. B., aged 74, had had enlarged prostate for thirteen years. Catheterized himself for ten years. Severe pain and haematuria after making a false passage. Bladder distended. Complete retention. Patient very ill, dry tongue, etc. Temperature 100°.

May 2nd, 1920.—Cystotomy.

May 3rd.—Blood urea, 50.4 mg. per 100 c.cm.

May 17th.—Blood urea, 42.0 mg. per 100 c.cm.

May 25th.—Blood urea, 35.0 mg. per 100 c.cm.

Owing to continued haemorrhage from the prostate, prostatectomy was performed May 31st, 1920, although the blood urea figures remained high. The patient died within twenty-four hours.

Post-mortem examination revealed prostatic tissue still remaining; the kidneys were markedly granular, with narrowing of the cortex.

The next two cases are examples of badly infected patients with impaired renal function; prostatectomy not performed.

Case 10.—J. A., aged 74, had symptoms for about a year. Had been catheterized frequently. Bladder grossly infected. Catheterization very difficult and painful. Patient rapidly getting worse; vomiting; dry tongue, etc.

May 24th, 1920.—Blood urea, 43.0 mg. per 100 c.cm. Cystotomy.

June 7th.—Blood urea, 33.6 mg. per 100 c.cm.

The patient's general condition was much improved but the blood urea figures remained high; prostatectomy discussed but rejected by patient and relatives. Permanent suprapubic apparatus fitted.

Case 11.—F. W. D., aged 60. Admitted with retention. Urine 1005, alkaline, large quantity of blood.

May 31st, 1920.—Blood urea: Finding faulty owing to technical error. Cystotomy.

June 7th.—Blood urea, 179 mg. per 100 c.cm.

The patient died uraemic on June 8th, 1920.

Post-mortem examination revealed thickened capsule of kidneys, stripping with difficulty; cortex narrowed and not well differentiated. Renal pelvis on both sides showed marked thickening with considerable evidence of recent inflammation of the mucosa.

Malignant Disease of Prostate.

Case 12.—J. P., aged 63. History of frequency and some haemorrhage. Quantity of pus in urine.

July 12th, 1920.—Blood urea, 42 mg. per 100 c.cm.

July 15th.—Cystotomy.

July 21st.—Blood urea, 38.0 mg. per 100 c.cm.

July 26th.—Blood urea, 28.0 mg. per 100 c.cm.

August 26th.—Prostatectomy.

Very hard prostate removed with difficulty. Microscopically an adeno-carcinoma. The growth rapidly recurred in the bed of the prostate, the suprapubic fistula failed to close, and a permanent suprapubic apparatus was fitted.

Case 13.—R. W., aged 69. Previous history lacking.

July 12th, 1920.—Blood urea, 61.6 mg. per 100 c.cm. Cystotomy.

Obvious malignant prostate. Nodules in trigone.

July 23rd.—Blood urea, 50.4 mg. per 100 c.cm.

Permanent suprapubic drainage apparatus fitted.

Case 14.—E. J. B., aged 69. Twelve months' history. Admitted with retention. Patient very ill, tongue dry, occasional vomiting.

July 14th, 1920.—Blood urea, 48 mg. per 100 c.cm.

July 15th.—Cystotomy.

July 20th.—Blood urea, 41.4 mg. per 100 c.cm.

August 24th.—Blood urea, 30 mg. per 100 c.cm.

The patient died on August 26th, 1920.

Post-mortem examination revealed a malignant prostate with involvement of the bladder wall. Both kidneys showed extreme pyelonephritis, with foci of necrosis scattered throughout the medulla and cortex.

Case 15.—W. H., aged 70. Hard, fixed and nodular prostate. Urine loaded with pus.

April 8th, 1920.—Blood urea, 46 mg. per 100 c.cm.

April 17th.—Blood urea, 56 mg. per 100 c.cm.

Retention relieved by catheter. The patient left hospital April 30th, 1920.

Cases 16, 17, 18.—Blood urea estimations were made in three other cases of enlarged prostate. The figures were:

W. E., aged 59. Blood urea, 12 mg. per 100 c.cm.
H. H., aged 63. Blood urea, 15.4 mg. per 100 c.cm.
J. L. H., aged 67. Blood urea, 16.8 mg. per 100 c.cm.

Prostatectomy was successfully performed in these cases.

COMMENTARY ON THE CASES.

The following conclusions can be drawn from the examination of the figures in these cases:

1. The blood urea concentration corresponds very closely with the clinical symptoms. In those cases (Nos. 1 and 2) where the patient was becoming uraemic the blood urea concentration was high.
2. Impaired renal function occurs in patients who have no infection of the urinary tract, the renal impairment being due entirely to back pressure. (Cases 1 and 2.)
3. Severe infection of the urinary tract (? confined to bladder) may be present without impaired renal function. (Case 8.)
4. The majority of cases of serious infection had impaired renal function.
5. A decided fall in blood urea concentration occurs after cystotomy, in the majority of cases the blood urea figures falling practically to normal.
6. The seriousness of those cases in which the blood urea figures remained high after cystotomy. (Cases 9, 11, and 14.)

I think it will be agreed that many of these cases were saved by preliminary cystotomy; of course, this was combined with general treatment on the ordinary lines—free administration of fluids, purgation, light diet, urinary antiseptics, diuretics, etc. In some cases cardiac and pulmonary complications required attention. In this series there was no case of glycosuria or tabes or other nervous disease. The cystotomy was done under local anaesthesia, and the bladder emptied slowly. In some cases of extreme distension a catheter has been passed and the bladder gradually emptied during twenty-four hours, the cystotomy being then performed. This avoids the risk of reflex suppression, haemorrhage and shock which may follow rapid and complete emptying of a very distended bladder either by the catheter or by suprapubic cystotomy. In one or two cases painful spasm of the bladder has occurred when it has been evacuated too quickly through the suprapubic wound.

Certain surgeons, notably Young, believe that suprapubic drainage is not often required and that regular catheterization is generally sufficient in infected cases and cases with impaired renal function. On the other hand, it is well known that the patient with impairment of renal function is apt to succumb rapidly after catheterization. I believe that when the blood urea figures are high cystotomy is an essential, and much to be preferred to regular catheterization or to the use of the tied-in catheter. In badly infected cases there is no comparison in the efficiency of the two methods of draining the bladder: cystotomy with antiseptic instillation is infinitely preferable to catheterization. An objection to the performance of a preliminary cystotomy is that one may find a high blood urea figure persisting after the cystotomy and contra-indicating prostatectomy. The patient must then be fitted with a permanent suprapubic drainage apparatus. It is conceivable that he might have preferred to end his days getting such relief as is possible from the catheter. This point must be explained to the intelligent patient.

INFECTION OF THE URINARY TRACT.

This may be present with or without any impaired renal function. We have at present no means of safely ascertaining in these cases whether an infection is limited to the bladder or whether it has involved one or both kidneys. Bilateral ureteral catheterization is not to be thought of in such cases as we are considering. Nor have we any means of ascertaining in any given case whether impaired renal function is due to the effects of back pressure alone or to back pressure and pyelonephritis. No doubt the kidneys may be infected without their function being impaired. In such cases the blood urea figures will remain normal. It is conceivable also that one kidney may be grossly infected, indeed partially destroyed, and the other kidney carrying out the work of excretion in such a way that no blood urea concentration is found. The clinical

signs are few and not reliable. If a patient with fever, rigors, pyuria, a dry tongue, vomiting, etc., has tenderness and enlargement of the kidneys there is no difficulty; but it is otherwise when the clinical signs are very slight. The matter is of great importance from the fact that a patient without definite clinical signs of renal infection and without any evidence of impaired renal function may after prostatectomy succumb to an acute pyelonephritis.

I have only been able to trace one case during the last year in which fatal pyelonephritis followed prostatectomy, where a preliminary blood urea test showed no impairment of renal function. My colleague, Mr. Walter Thompson, has kindly allowed me to refer to the case.

The patient, a man aged 58, was admitted with an enlarged prostate causing extreme frequency of micturition and sometimes nocturnal incontinence. The urine was 1020 specific gravity, and contained a trace of albumin. The blood urea test showed 19.6 mg. per 100 c.cm. on October 25th, 1920. Prostatectomy was performed on November 4th, and the patient died on November 11th, 1920. *Post-mortem* examination showed an intense inflammation of the bladder with pyelitis and multiple abscesses in both kidneys.

Control of Infection.

A great deal can be done in infected cases to control the infection of the bladder or bladder and kidneys before prostatectomy is performed. The ordinary routine treatment of the infected bladder may be carried out, namely, regular catheterization, the administration of urinary antiseptics by the mouth, washing out the bladder once or twice daily with an antiseptic through the catheter, etc. Or a preliminary cystotomy may be done, and lavage of the bladder performed through a catheter or through the drainage tube. These methods are in many cases all that is necessary, but in all probability improvement is due mainly to the emptying of the bladder rather than to the lavage. For some years I have been treating the infected bladder on the lines laid down by Carrel for the treatment of infected wounds. In every case in which a cystotomy is done a drainage tube with two Carrel tubes attached is passed into the bladder; through these Carrel tubes two ounces of an antiseptic solution is injected into the bladder every two hours. The Carrel tubes have holes at intervals and the solution must come into contact with practically every part of the bladder mucosa. The patient is kept dry by a Hamilton Irving apparatus, a most satisfactory appliance in the hands of a capable nurse. The antiseptic I usually employ is the ordinary eusol solution, sometimes diluted to half-strength; Dakin's solution is too irritating; flavine I have thought comparatively ineffective. We have endeavoured to estimate the extent to which the infection is controlled by using an antiseptic in this way by various methods: by counting the number of organisms in a film taken from the suprapubic wound; by estimating the amount of pus in the urine over a given period. These methods have proved quite unreliable and very difficult to carry out. One can only judge by clinical results. It can be said with certainty that the amount of pus materially diminishes, that offensiveness of the urine quickly disappears, and that such complications as cellulitis of the *cavum Retzii* and phosphatic deposit in the suprapubic wound do not occur. I have said before that we have no means of telling whether the kidneys are infected as well as the bladder; neither have we any means of determining the effect of treatment on these lines on the infection of the kidneys. One can only give one's impressions gathered from ordinary clinical observation. I am convinced that drainage of the bladder with regular instillation of an antiseptic into the bladder has a very marked effect on infection of the kidneys.

There is another advantage in the regular instillation of an antiseptic into the bladder on the Carrel principle. Cases of acute infection of the bladder following the establishment of suprapubic drainage in cases of fractured spine, gunshot wounds of the spine, etc., are not unknown. In such cases the infection occurs via the drainage tube; it can be prevented by the instillation of an antiseptic. It is probable that if preliminary cystotomy were carried out in those cases of retention with impaired renal function but as yet uninfected, infection via the drainage tube would readily occur. We know it occurs very readily by a catheter, and I do not think I would venture to drain such

a case without taking the precautions to prevent infection which are available by regular instillation of an antiseptic. One may say with truth that, as a catheterized bladder will be an infected bladder, so also will a drained bladder.

Infection after Prostatectomy.

Some degree of inflammation of the bladder probably occurs in every case after suprapubic prostatectomy, generally because the bladder was already infected. In the ordinary case the infective process causes no anxiety, it does not lengthen the period of convalescence, and it does not persist after the wound is healed. But septic changes occurring in the bed of the prostate may have serious consequences; sometimes a more or less prolonged suppuration occurs; epididymitis is not uncommon; septic thrombosis of the prostatic veins leads to pelvic phlebitis with oedema of the legs, or even pulmonary embolism. Further, the infection may spread to the kidneys and cause pyelitis, pyelonephritis, pyonephrosis, or multiple abscess formation in the substance of the kidney. It is probable that in the majority of cases in which these serious complications arise the kidneys were infected before operation; but, as I have said before, we have no means of determining this with safety. These septic complications are particularly likely to arise in cases with dilated ureter orifices and impaired renal function.

In order to minimize the risk of these complications occurring I believe that antiseptic instillations should be continued after the prostate has been removed. The drainage tube, not too large, with two attached Carrel tubes, is used for the first few days; then, the drainage tube being discarded, one Carrel tube is inserted into the bladder; later, if thought advisable, a double-channelled catheter is passed and the instillations continued through one channel. Instillation is deferred for the first twelve hours after operation to avoid the risk of disturbing clot and exciting haemorrhage; instillation is much less likely to induce a secondary haemorrhage than is bladder lavage. True secondary haemorrhage is due to septic changes in the bed of the prostate, and these changes are much less likely to occur when regular antiseptic instillation is practised.

It is important not to be in too great a hurry to obtain healing of the suprapubic wound after prostatectomy, in cases of serious infection of the bladder. I was asked lately to see a case where the wound had healed and the patient was passing urine ten days after prostatectomy, but pyuria persisted and increased, and the patient died from septic pyelonephritis.

USE OF BLOOD UREA ESTIMATION IN DETERMINING THE NEED FOR PROSTATECTOMY.

Some degree of enlargement of the prostate is extremely common. Many elderly men suffer from frequency of micturition, and examination shows a degree of enlargement, with some residual urine. A large proportion of these men never experience any really serious trouble with the prostate. If they are not interfered with and not infected, they end their days comfortably, despite the disability. Prostatectomy is here unnecessary and meddling. They may even have an attack of retention, necessitating the use of the catheter for a few days. If not infected, recovery may ensue and no active treatment be required. But they require watching very carefully, and here the value of the blood urea test is most noticeable. If the proportion of urea in the blood shows a tendency to rise steadily in a patient known to have an enlarged prostate, even if his symptoms are not aggressive and there is no infection, haemorrhage, or distension of the bladder, the desirability of prostatectomy must be considered.

CONCLUSIONS.

1. Blood urea estimation is a reliable guide to the functional capacity of the kidneys.
2. Its estimation should be carried out in every case of enlarged prostate before operation.
3. Blood urea figures over 25 point to the desirability of a period of preliminary treatment, with drainage of the bladder either by catheter or through a cystotomy wound.
4. If the tied-in catheter is used further blood urea estimations will show whether improvement is taking place.
5. If not, a cystotomy should be done and further estimations carried out.

6. When the blood urea figures fall to under 30 prostatectomy may be done, the general condition of the patient being in other respects satisfactory.

7. In preliminary cystotomy and regular antiseptic instillation we have a method of dealing with cases of impaired renal function, whether due to back pressure only or to back pressure and renal infection. We can estimate the impairment in renal function by estimating the blood urea; we can only estimate the improvement in the infection of the kidneys by ordinary clinical observation. If the blood urea figures are normal, with a badly infected bladder, it is probable that one may assume that the kidneys are not yet infected.

DISEASES OF INFANTS DUE TO PROLONGED FEEDING WITH EXCESS OF CARBOHYDRATES.

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CHILDREN'S as well as adults' food must consist of a suitable mixture of protein, carbohydrate, and fat, besides water, salts, and some indefinite specific substance, though of course it is known that adults can live for a considerable time on a diet mainly composed of two of these substances. Here in Denmark Hindlede has shown that it is possible to exist on a diet comparatively free from protein, so long as it contains plenty of carbohydrate and fat; and the Eskimos' mode of living, and our experiences in the treatment of diabetes, show that man can live quite well on a diet chiefly consisting of protein and fat. On the other hand, it is beyond question that in the long run man suffers from such a one-sided diet, and if left to himself he will always try to vary his food.

As regards infants, we know that they too can thrive for some time on a diet poor in protein. Some years ago Biedert's cream treatment was much in use for infants; this was, however, abandoned, not because cream is particularly poor in protein and thus has a detrimental effect, but because the children, owing to the excess of fat, suffered from acute or chronic dyspepsia, leading occasionally to atrophy.

Feeding with Finkelstein's albumin-milk, which, when it was first tried, consisted almost exclusively of protein and fat, showed that infants are very sensitive to an insufficient supply of carbohydrates. Even a short course of this diet may lead to collapse. Carbohydrates are essential for infants, and they will digest not only sugar, but small quantities of starch also.

Formerly all starchy food was considered most harmful to infants, and diseases such as rickets, anaemia, and scurvy were ascribed to it. All the old specialists in diseases of children, therefore, prohibited the use of starch in the diet of children under 12 months. We now know that this is not so, and we give starchy food to infants suffering from a number of complaints, with great benefit. Buttermilk, malt and skimmed milk, contain, in addition to protein, large quantities of carbohydrates, consisting of sugar and starch, and this diet apparently often suits the infants admirably. It is, however, destitute of fat, and it is for this reason, as well as on account of its richness in carbohydrates, that it improves the condition of infants suffering from chronic dyspepsia and infantile atrophy.

The question whether infants can thrive without fat is at present of particular interest in Germany and Austria-Hungary, where there is a considerable shortage of fats. Pirquet has investigated this question, and has recently published his results. He changes abruptly from the ordinary diet to one in which fat is lacking, feeding the children on centrifuged milk to which is added plenty of cane sugar. In spite of the sudden change of diet he can find no change in the children's condition; they thrive and develop as before. Pirquet comes to the conclusion, therefore, that there is no apparent fat minimum for man, so long as the absence of fat is made up for by double the quantity of carbohydrate. That this conclusion is wrong the following considerations seem to prove.

As regards adults, we have no record of a diet consisting solely or chiefly of only one of these substances. No man will, of his own accord, live on protein alone, fat alone, or carbohydrate alone. The only instance of such a diet