

will fit his environment, and so to arrange the environment or so to place the patient that the environment fits him. Sometimes it cannot be done. Our laws and customs contain fragments from the dark ages and more primitive eras. So do we. Some of us belong to the period about 100 A. D. For such, transplantation to the present epoch is difficult. A few of us belong in the stone age, and we cannot live in the captivity of modern civilization without falling ill. Perhaps occasionally one is 500 years ahead of his time. If so, he has a hard life, and probably is a failure, judged by our standards.

In assisting to adjust a patient to necessary conditions, frequently we have to show him that he can do things that he says he cannot do. That is his way of expressing his great reluctance to do or fear of doing something necessary for his health. Demonstration discounts admonition. He should be given an understanding of his situation; but simply telling him is not enough. We must demonstrate to him that he can eat turnips or walk a mile or sleep without a hypnotic or go without a headache powder.

Let me again emphasize that the headache or the pain in the legs or indigestion is simply a means of escape from something for which the patient feels himself inadequate, or really is inadequate. Our job is to make him equal to the task he is trying to escape or so modify the task that he can perform it, or give him another which he can do with satisfaction. To say, "Don't worry" or "Why Worry?" or "That headache isn't in the least serious" is not enough. The unwholesome ideas, the distressing disorder, can be driven out only by wholesome satisfactory ideas, which in the vast majority of cases means a satisfying occupation, a something which makes life taste good.

#### THE OUTCOME

And for our encouragement, we may remember that the temperamental individual who is confused and discouraged by life's perplexities and takes refuge in physical disabilities is, when rightly placed, likely to be the finest enthusiast, the most glowing optimist. Just as he is dominated and defeated by a depressing idea, so is he exhilarated and activated by sanguine ideas. Some of the greatest and most beautiful work of all time has been done by these men and women who are too much controlled by their emotions, too sensitive to the jars of a battling society, too unstable to carry the gross burdens of a materialistic world. Ours the task, then to strengthen their intellectual control, to toughen their shrinking sensibilities, and adjust the burden to the bearer. Thus may we, too, add to the sum total of human health, happiness and progress.

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**Diet and Health.**—A lack of the knowledge of how to adjust income and food expenditures is holding many children back in normal development, and thereby decreasing the ability of future citizens. Oftentimes medicine can be of no lasting value until the diet is regulated, and quite frequently when the diet is regulated medicine is unnecessary; but in the majority of cases the doctor has not the time to sit down and plan this adjustment with the mother, and the problem of food economics is a work apart from nursing, just as nursing is apart from the practice of medicine. To meet just such a situation as this the nutrition specialist in social work has come into existence.—L. L. Gillett, *The Commonwealth* 6:111 (May-June), 1919.

## PELVIS OF KIDNEY AS POSSIBLE SOURCE FOR INFECTION OF BLOOD STREAM

### PRELIMINARY REPORT \*

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During recent years it has been generally conceded that in cases of renal infection the kidney is infected secondarily following a primary bacteremia. In some instances it seems that the kidney, previously infected either through the blood stream or by an ascending infection, may be the cause from which a bacteremia results. For the purpose of investigating this interesting problem, experiments have been conducted under the direction of the Departments of Urology, of Experimental Bacteriology, and of Experimental Surgery, with reference to the following questions:

1. Can organisms pass from the pelvis of the kidney into the blood stream?

2. Are the conditions under which they pass at all analogous to the pathologic status found clinically?

3. Are there clinical cases in which the kidney has acted as a focus of infection?

Our investigations have been concerned, as yet, only with the first two of these hypothetical questions.

The literature concerning the absorption from or the passage of organisms through the kidney is very meager. Albarran<sup>1</sup> was the first to investigate experimentally the infections of the blood stream through the kidney. In 1888, working with *Bacillus pyogenes*, which was afterward identified as *Bacillus coli* by Krogus, Achard and Renault,<sup>2</sup> he produced infection in the blood stream by introducing *Bacillus pyogenes* into the ureter. His work was without previous bacteriologic control of the blood, however, and in many cases peritonitis occurred. He traced the organism from the bladder to foci of infection in the kidney. "From these foci the organisms go into the connective tissue and then penetrate into the blood vessels, enter the circulation, and lead to far off emboli." Thus it is seen that thirty years ago the thought was suggested that the kidney might be a focus for blood stream infection.

Burns and Swartz<sup>3</sup> do not believe that absorption takes place from the pelvis of the kidney under normal conditions. If an acute pyelitis occurs, however, absorption, and the clinical phenomena of chills and fever result. These authors consider such clinical manifestations as due to the absorption of urine and bacterial toxin either from the blood vessels or lymphatics of the renal pelvic mucosa directly, or from the urine and bacterial toxins retained in the uriniferous tubules. They do not suggest, however, that these clinical symptoms may be due to the passage of the bacteria through the kidney into the blood stream, thus causing a bacteremia. In their later work, after the injection, by the gravity or syringe method, of indigo-carmin and india ink particles into the previously

\* From the Mayo Clinic.

1. Albarran, J.: Étude sur le rein des urinaires, Thèse de Paris, 1888.

2. Krogus, Achard and Renault, quoted by Brown, T. R.: The Bacteriology of Cystitis, Pyelitis and Pyelonephritis in Women, with a Consideration of the Accessory Etiological Factors in These Conditions, and of the Various Chemical and Microscopical Questions Involved, Johns Hopkins Hosp. Rep., 10:11-89, 1902.

3. Burns, J. E., and Swartz, E. O.: Absorption from the Renal Pelvis in Hydronephrosis Due to Permanent and Complete Occlusion of the Ureters, J. Urol. 2:445-455 (Dec.) 1918.

ligated ureter, they found these substances in the opposite kidney, in the liver, lungs, and spleen. They then conclude: "It is reasonable to suppose that if particles of ink can travel in this manner, bacteria and other foreign substances can do likewise."

Macht<sup>4</sup> states that certain drugs or poisons may be absorbed through the walls of the ureter and the kidney pelvis. Weld<sup>5</sup> has shown with what ease certain drugs may be absorbed from the renal pelvis, and the untoward action of some of them. Weld's finding that "absorption from the kidney pelvis indicates that the kidney may be a focus of infection which should always be considered" stimulated me to make the present investigation.

#### EXPERIMENTAL WORK

Dogs were used in all the experiments. The animals were etherized with a constant ether tension; their condition was kept as near normal as possible by the judicious use of heat, etc. In some of the experiments the blood pressure was recorded. All operative manipulations were carried out with the minimum of trauma and hemorrhage. *Bacillus prodigiosus* was the organism chosen, since it is easily identified, since it

TABLE 1.—RESULTS OF EXPERIMENTS IN SERIES 1

Experiment	Pressure Above Kidney Pelvis, Cm. of Water	Positive Cultures of <i>Bacillus Prodigiosus</i>
550-19	20 to 30	1. Renal vein 2. Left kidney cortex 3. Left kidney medulla
560-19	20 to 30	1. Left kidney medulla
562-19	20 to 30	1. Left kidney cortex 2. Left kidney medulla
565-19	10 to 30	1. Heart blood 2. Liver 3. Renal vein, A and B
592-19	20 to 30	All cultures negative
618-19	20 to 30	1. Left kidney cortex
620-19	20 to 30	1. Left kidney cortex
630-19	20 to 30	1. Left kidney cortex 2. Right kidney cortex
649-19	20 to 30	1. Left kidney cortex
654-19	20 to 30	1. Left kidney cortex
657-19	20 to 30	1. Left kidney cortex
666-19	20 to 30	All cultures negative

probably never occurs spontaneously in the sites from which cultures were taken, and since it is rarely the cause of bacterial contamination in the laboratory. The bacillus was grown in broth cultures and injected by the gravity method.

A straight glass tube about 2.5 mm. in diameter was connected by a T-tube to a cannula inserted into the ureter and to a graduated buret. The straight glass tube was graduated in cubic millimeters. A stopcock was inserted on each side of the T-tube. The fluid containing the bacteria was placed in the buret and allowed to flow into the graduated tube to any desired height. At this definite and controlled pressure it was then allowed to enter the ureter. Great care was taken to exclude air from the entire system and not to contaminate adjacent tissues.

The dogs were killed with ether at the end of from two to three hours, and cultures taken from the heart's blood, the lungs, liver, spleen, inferior vena cava opposite the renal vein, right kidney cortex and medulla, and left kidney cortex and medulla. The cultures were made by planting from 2 to 5 c.c. of blood and from 0.2 to 0.5 c.c. of the tissue juice of the various

organs into tall tubes of glucose broth. The material from the tissues was obtained by aspirating the macerated particles and juice into sterile pipets. The inoculated tubes were allowed to stand at room temperature for from forty-eight to ninety-six hours. The positive cultures were then plated on plain agar.

TABLE 2.—RESULTS IN SERIES 2

Experiment	Pressure Above Kidney Pelvis, Cm. of Water	Positive Cultures of <i>Bacillus Prodigiosus</i>
531-19	78	1. Left kidney cortex 2. Left kidney medulla
534-19	70	1. Heart blood 2. Right kidney 3. Liver 4. Renal vein?
701-19	60	1. Lung 2. Renal vein, A and B 3. Heart blood, A and C 4. Right kidney cortex 5. Left kidney cortex 6. Right kidney medulla 7. Liver, A and B 8. Spleen
800-19	60	1. Renal vein 2. Left kidney cortex
801-19	60	1. Liver, A and B 2. Renal vein, A, B and C 3. Heart blood, A, B and C 4. Spleen 5. Right kidney cortex
802-19	60	1. Liver, A and B 2. Spleen
803-19	78	1. Heart blood, A, B and C 2. Renal vein, 1 and 2 3. Liver, 1 and 2 4. Left kidney cortex

SERIES 1.—In the first series, through a lumbar incision a cannula was inserted into the left ureter from 2 to 4 cm. from the pelvis of the kidney. A twenty-four hour broth culture of *Bacillus prodigiosus* was then permitted to flow into the pelvis at from 10 to 30 cm. pressure. From two to three hours afterward the dogs were killed with ether and cultures made as outlined above. Results are shown in Table 1. In twelve experiments even with this low pressure, *Bacillus prodigiosus* was recovered from the blood stream or other organs in three instances. It was found in the left kidney in all but two of the experiments.

SERIES 2.—The procedure in the second series was the same as in the first, with the exception that the pressure at which the organisms were passed into the ureter was increased to from 60 to 78 cm. Results are shown in Table 2. At this pressure, which was slightly less than the secretory pressure of the kidney, the organisms were recovered from the blood stream or other organs in six of seven experiments, and they were recovered from the left kidney in all.

TABLE 3.—RESULTS IN SERIES 3

Experiment	Pressure in Left Ureter, Cm. of Water	Pressure in Right Ureter, Cm. of Water	Positive Cultures of <i>Bacillus Prodigiosus</i>
729-19	20	65	1. Lung 2. Heart blood, A, B and C 3. Renal vein, A and B 4. Liver 5. Right kidney cortex 6. Left kidney cortex
756-19	20	64	1. Renal vein 2. Liver 3. Left kidney cortex
760-19	20	78	1. Liver 2. Left kidney cortex
801-19	20	50	1. Heart blood 2. Left kidney cortex
805-19	20	65	All cultures negative

SERIES 3.—In the third series in addition to the procedure followed in Series 1 and 2, a cannula was inserted into the right ureter 4 cm. above the bladder; to the cannula was attached a straight glass tube. The cannula inserted into the left ureter was also 4 cm. above the bladder. A forty-eight hour broth culture of *Bacillus prodigiosus* and washings from forty-eight hour agar slants were placed in the buret and allowed to flow into the left ureter, while the pressure was

4. Macht, D. I.: Concerning the Absorption of Drugs and Poisons from the Ureter and Pelvis of the Kidney, J. Urol. 2: 481-485 (Dec.) 1918.

5. Weld, E. H.: Renal Absorption with Particular Reference to Pyelographic Mediums, Med. Clin. North Am., to be published.

kept under 21 cm. The tubing connected with the cannula in the left ureter was then clamped. The femoral vein was isolated, and from 100 to 150 c.c. of a 5 per cent. sodium sulphate solution were injected slowly. The secretory pressure of the right kidney was measured in the graduated tube connected with the right ureter. After from two to three hours the routine procedure as previously described was carried out. The organisms were introduced under a very low pressure and the intrapelvic pressure was subsequently increased by stimulation of the kidney. The results are shown in Table 3. In four of these five experiments, *Bacillus prodigiosus* was recovered in other organs than the kidney.

It may be concluded, therefore, that bacteria can pass from the kidney pelvis into the blood stream, and that they may do this under conditions analogous to some of the pathologic states found in man.

### INTRAVENOUS INJECTIONS OF HYPERTONIC GLUCOSE SOLUTION IN INFLUENZAL PNEUMONIA

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One of the trying experiences of the medical profession during the late pandemic of influenza was the apparent helplessness in the treatment of the chief complication, pneumonia. The experience at the Camp Travis Base Hospital probably paralleled that of other similar institutions. At first, only the commonly accepted methods of treatment were used; but it soon became evident that some additional measures must be employed, else a very high mortality would result. At this hospital, resort was made to the use of quinin because of its recognized pneumococcal action, and to the intravenous injections of hypertonic glucose solution. The results following the quinin medication are to be reported by others. The good results following the glucose treatment are attested by a relatively low mortality. This report deals with the results obtained in 319 cases of influenzal pneumonia, in which one or more injections of a sterile hypertonic glucose solution were used.

The use of glucose in the treatment of serious diseases is not new; heretofore, its use has been restricted chiefly to administration by mouth and rectum for the purpose of supplying the organism with a food easily assimilated and of high caloric value. Litchfield<sup>1</sup> has recently urged the intravenous use of hypertonic glucose solution in serious diseases. The present report is offered because it comprises the largest series of cases on record in which the intravenous use of a hypertonic glucose solution has been intensively employed in the treatment of pneumonia.

#### PREPARATION OF SOLUTION AND TECHNIC OF INJECTION

The solutions were prepared in the base hospital laboratory from chemically pure glucose: Several thousand cubic centimeters of a solution of a desired strength were prepared in distilled water brought

slowly to the boiling point in order to dissolve the glucose, and filtered through a heavy layer of cotton to remove any gross contamination; then they were made up to the original volume, autoclaved at 20 pounds pressure for twenty minutes, again filtered through several layers of filter paper and made up to the original volume with distilled water, after which the solution was distributed into suitable flasks, holding about 300 c.c. These flasks after being properly stoppered were again autoclaved, and set aside for use as needed. The necessity for several filtrations is important, for in our experience, the boiling as well as the autoclaving tended to precipitate foreign matter which otherwise would be injected. We have used solutions of four strengths in this series: 5, 10, 15 and 25 per cent. strengths of glucose.

The technic of injection and the apparatus are those commonly employed in the intravenous injection of arsphenamin. Any large vein is suitable for puncture, usually one in the antecubital space being selected. Only three precautions should be taken: First, the solution, containers, tubing and needles should be sterile. Second, the solution as it enters the vein should be kept slightly above body temperature; this may be accomplished by placing the rubber tubing in a basin of warm water. Third, the solution should be injected slowly; it should require from thirty to forty minutes to complete the injection of from 250 to 300 c.c. We have found that if the fluid is allowed to flow from the needle before puncture at the rate of from sixty to ninety drops per minute this precaution will have been taken. A pinch-cock attached to the rubber tubing is used to control the rate of flow.

#### RESULTS IN THREE GROUPS OF CASES

For the purpose of comparison, the cases in this series are divided into three groups, based on as accurate a prognosis as possible at the time of the injection. Group 1 includes those patients who were seriously ill, but who were expected to do reasonably well under the usual methods of treatment. Group 2 includes those patients who were critically ill, but who had a fighting chance for recovery under the ordinary methods of treatment. Group 3 includes those patients

TABLE 1.—RESULTS OBTAINED IN A SERIES OF THREE HUNDRED AND NINETEEN CASES

	Group 1		Group 2		Group 3	
	A	B	A	B	A	B
Number of patients injected.....	75	37	87	37	51	32
Deaths.....	0	0	8	0	24	20
Mortality, per cent.....	0	0	9.1	0	66.6	62.5
Average day of disease on which first injection was given.....	2	4.2	1.8	4.6	2	5
Average length of febrile period in days.....	4.5	8.2	4.9	9.6	5.6	9
Complications.....	4	2	6	4	4	1

who invariably died under the former methods of treatment. Many of the patients in the latter group did not receive glucose injections until late, other methods being tried first, only to fail; many were practically moribund at the time of the first injection, as will be noted in the illustrative cases. The subdivision of each group into A and B denotes the day of the disease on which the injections were given. In Group A the injections were made on the first, second or third day of the disease; while Group B includes patients in whom injections were made after the third day. Table 1 shows the results obtained in 319 cases, as regards mortality and length of febrile period.

1. Litchfield, Lawrence: Glucose Intravenously as a Therapeutic Measure, J. A. M. A. 71: 503 (Aug. 17) 1918.