CONCLUSIONS

1. The amino-acid nitrogen of the blood varies within certain definite limits (4.5 to 8.5 mg. per hundred c.c.) in different individuals.

2. A similar variation occurs in the same individual at different times.

3. The amino-acid nitrogen in the spinal fluid in different individuals, and also in the same individuals at different times, varies between approximately 2 and 4 mg. per hundred c.c.

4. The amino-acid nitrogen content of the blood in syphilitics varies within exactly the same limits as in the blood of non-syphilitics. The amino-acid nitrogen content of neither the blood nor spinal fluid of a syphilitic bears any relation to the Wassermann reaction.

5. The conclusion of Kaplan and of Kaplan and McClelland that in patients with syphilis the amino-acid nitrogen of the blood is diminished, and that such determinations may be used as a means of diagnosis, is incorrect.

THE EFFECTS OF COLLARGOL AS EMPLOYED IN PYELOGRAPHY

AN EXPERIMENTAL STUDY*

DANIEL N. EISENDRATH, A.B., M.D.
CHICAGO

Prompted by the report of a number of cases of ill effects, even death, following the injection of collargol into the renal pelvis for roentgenographic purposes, I became interested in the question of whether or not collargol can damage the kidney and can cause death when so injected. With the assistance of Dr. E. W. Schnoor and Miss Elizabeth Byrne, we have attempted to study the question from every angle, employing dogs and measuring the pressure with which the fluid was injected. With the exception of some experiments on pigs' kidneys (removed from the body), reported by Whitman,[1] we are the first to study the question by not only measuring the amount injected, but also observing the effects of varying this quantity, as well as the pressure with which it is injected.

We believe that we are able to show from the lesions found in our experiments on healthy and diseased kidneys injected with various substances (collargol, cargentos and methylene blue) that the majority of the ill effects[2] reported up to the present time have been due to lack of consideration of the fact that when the capacity of the human renal pelvis is exceeded by the amount of fluid injected, and a high degree of pressure employed, the solution is either forced into the loose tissues around the renal pelvis and kidney, or into the renal parenchyma, and from here into the circulation and deposited in various viscera.

TECHNIC

Dogs were employed in all of the experiments. Under ether anesthesia and all aseptic precautions the bladder was opened and a ureteral catheter, which could be boiled, inserted through the vesical orifice of the ureter to be injected, until one could see the location of the eye of the catheter through the intact wall of the ureter above the bladder, in order to watch the first escape of fluid from the catheter. We could thus closely observe the quantity injected into the renal pelvis, and the pressure employed. A mercury manometer, inserted into the column of the solution injected, enabled us to note the slightest fluctuations in pressure. After the fluid had been injected, the catheter was withdrawn and the bladder incision sutured. We were able to imitate perfectly the method of using collargol in the human being. Only one animal out of a total of forty showed evidences of infection, so that we can eliminate this as a factor in interpreting our results. In Experiment 316, as well as in the experimental hydronephrotic and infected kidneys, the solutions were injected directly into the proximal end of the ureter.

PLAN OF THE EXPERIMENTS

The average capacity of the renal pelvis of the dog is from 2 to 2.5 c.c. We thought that by filling the renal pelvis with this amount, or one slightly above it, we could best imitate the gravity method which is correctly held to be least dangerous in the human being. We found that when a buret filled with collargol was raised to a level of 3½ feet above the operating table, the fluid escaped under a pressure of 29 mm. Our first series corresponds to the average gravity injection, as given daily. In the second series the quantity and pressure were increased moderately, and in the third series both were increased considerably, in order to ascertain as closely as possible how much pressure, and the amount of excess in fluid beyond that of the ordinary capacity of the renal pelvis, would be required to force the solutions into the kidney and its vessels. We killed the animals at different periods after the injection, in order to study the question of permanent injury to the kidney and other viscera. In addition to collargol in 10 and 20 per cent. solution, we undertook experiments with cargentos, a salt containing 50 per cent. silver, and also with methylene blue. In our earlier experiments only the injected kidney was examined. It was not known at that time that the collargol entered the blood-current when too much pressure or too large a quantity was employed, since our article[3] of May 2, 1914, was the first publication to describe such an occurrence.[4]

The first series shows that the injection of collargol under a pressure not to exceed 30 mm. will fill the renal pelvis. Only a minimal amount of the collargol enters the kidney parenchyma or infiltrates the peripelvic tissue. An elevation of 3½ feet of a column of fluid causes it to flow at a pressure of 29 mm.; hence this first series proves that the gravity method is the safest one to employ in injecting any solution into the renal pelvis.

* From the Morris Institute for Medical Research of the Michael Reese Hospital.
* Read before the Section on Genito-Urinary Diseases at the Sixty-Fifth Annual Session of the American Medical Association, Atlantic City, N. J., June, 1914.
* Because of lack of space this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.

1. Whitman: Referred to by Tennant: Ann. Surg., lvii, 888.

2. It will be impossible to quote the published reports of ill effects, owing to lack of space in the present article. Mason (Dangers Attending Injections of the Kidney Pelvis for Pyelography, THE JOURNAL A. M. A., March 14, 1914, p. 839) has reviewed these quite fully, and we will review them in our paper, when published in full.

3. Eisendrath, Daniel, N.: The Effects of Injecting Collargol into the Renal Pelvis, THE JOURNAL A. M. A., May 2, 1914, p. 1392.

4. At the time Experiments 304 and 310 were performed, we had not read the article by Rehn, Jr. (Centralbl. f. Chir., 1914, No. 4), in which he simply mentions the fact that he found collargol in other viscera, but does not give any details and has not published them up to the present time.

SUMMARY OF EXPERIMENTS

Series 1.—Ten per cent. collargol injected under low pressure.

There were six experiments in this series, the quantity injected varying from 2.25 to 3 c.c., that is, just equal or slightly beyond the capacity of the renal pelvis. A distinct resistance was felt when 3 c.c. had been injected, showing that no more collargol could be safely introduced into the

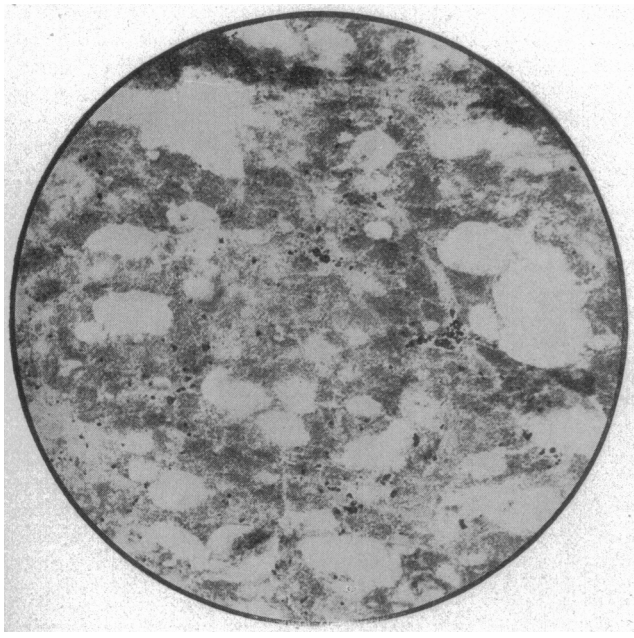

Fig. 6.—Lung from Experiment 327, showing hemorrhagic infarct around collargol.

renal pelvis. The pressure under which the collargol was injected varied from 13 to 32 mm. The first dog was killed immediately and the other five 24, 48, 72, 96 and 144 hours, respectively, after the injection. The only three findings of value were in the following three experiments:

Experiment 302: 2.75 c.c. at 13 mm. Killed immediately. Small amount of collargol in the interstitial tissue of medulla of kidney.

Experiment 306: 3 c.c. at 20 mm. Killed after 24 hours. Slight peripelvic collargol deposits.

Experiment 332: 2.4 c.c. at 32 mm. Killed 144 hours after injection. Kidney showed marked inflammatory reaction in medulla of kidney, and evidences of slight hemorrhages into lungs and spleen. Hemorrhages into the interstitial tissue of the kidney and into the glomeruli were found so constantly, even when sterile water was injected, that they were thought to be due to trauma rather than to the collargol.

Series 2.—Ten per cent. collargol injected under moderate pressure (30 to 70 mm.).

Experiment 313: 4 c.c. at 50 mm. Killed 24 hours later. Small amount of collargol in interlobular septa of lungs.

Experiment 314: 5.5 c.c. at 45 mm. Killed 48 hours later. Small amount of collargol in interstitial tissue and in blood-vessels of the injected kidney.

Experiment 322: 3 c.c. at 45 mm. Killed 96 hours later. Hemorrhages into renal parenchyma more marked than usual.

Experiment 319: 5 c.c. at 50 mm. Killed 144 hours later. Small amount of collargol in interstitial tissue of the kidney; also present in small amount in lungs and liver.

Experiment 317: 5 c.c. at 52 mm. Killed 20 days later. Small amount of collargol in the kidney, undergoing resorption, and in vicinity of this collargol there are evidences of intense inflammatory reaction. Small amount of collargol in the interlobular septa of lungs. Subcapsular and parenchymatous hemorrhages in spleen.

Experiment 312: 4 c.c. at 47 mm. Killed 30 days later. No collargol found, but injected kidney showed intense inflammatory reaction in the cortex.

COMMENTS ON SECOND SERIES

In Experiment 313, in which the capacity of the renal pelvis was slightly exceeded (4 c.c. at 50 mm. pressure), there was a small amount of collargol deposited in the lungs. In 314 (5 c.c. at 45 mm.), collargol was found both between the tubules and in the blood-vessels of the kidney. In 322, there were evidences of intense inflammatory reaction when the animal was killed 96 hours later. The same is true in 317, in which animal was killed 20 days after injection, as well as in 312, killed 30 days after injection. Evidently the deposits of collargol caused an intense inflammatory reaction, as the result of the presence in the tissues of a foreign substance. In 319, the collargol was forced into the renal blood-vessels and was deposited in small amount in the lungs and liver. In 317, there was collargol in the lungs and evidences of hemorrhages in the spleen.

Series 3.—Ten per cent. collargol injected under high pressure (70 to 140 mm. Hg).

Experiments 304 and 310 were reported May 2, 1914, as a preliminary communication.[4]

Experiment 304: 20 c.c. at 100 mm. pressure. Dog died five minutes after injection was begun. Injected kidney showed many black areas which proved to be collargol lying both within the tubules and in spaces between the tubules, which were of traumatic origin (Fig. 1). Lungs were of a deep black, and sections taken from all lobes showed numerous capillary and larger vessels filled (Fig. 2) with the collargol in the form of emboli. The liver and spleen both contained much collargol. The surface of the liver (Fig. 3) had many yellowish-brown nodules, due to collargol deposits or infarcts and the collargol was found within the lumen of many hepatic vessels (Fig. 4). The spleen and lungs showed in addition to the collargol, many hemorrhages.

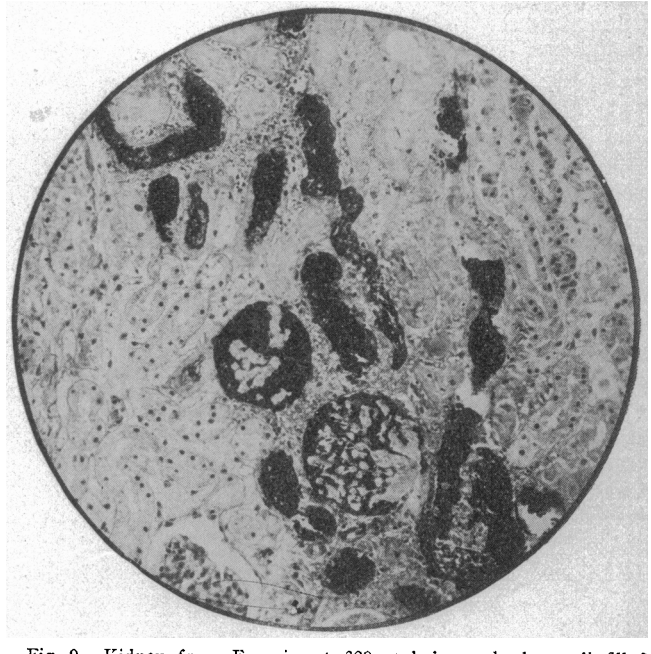

Fig. 9.—Kidney from Experiment 329; tubules and glomeruli filled with 20 per cent. collargol.

Experiment 310: 30 c.c. at 100 mm. pressure. Animal died thirty minutes later. There were a number of collargol infarcts in the injected kidney and the microscopic appearance was the same as in 304. The lungs showed much less collargol than in 304, but there was an extensive edema of the lower lobes. The liver and spleen showed evidences of hemorrhages, but contained less collargol than in 304. This was due to the fact that much of the collargol had

escaped into the tissues around the renal pelvis, and thus less entered the circulation than in 304. Death was undoubtedly due in this dog to the acute pulmonary edema, whereas in 304 it was the direct result of so many capillaries being filled by the collargol emboli.

In Experiment 316 the collargol was injected directly into the proximal ends of both ureters, in order to observe the rise in pressure as the quantity injected was increased. The pressure when 5 c.c. had been injected was 48 mm., and rose gradually until it was 98 mm., when 10 c.c. (four times the capacity of the renal pelvis) had been injected. Both kidneys showed the typical collargol deposits and infarcts. In other experiments of this series, in 303 (7 c.c. at 80 mm.) the kidney showed a typical collargol infarct when the organ was removed fifteen minutes later. In 321 (6 c.c. at 94 mm.) the dog died seven days after the injection. The lungs showed extensive ecchymoses on the pleura and pneumonia in the stage of red hepatization in several lobes. The close proximity of a number of particles of collargol to the pneumonic areas (Fig. 5) justifies, we believe, the conclusion that the collargol played an important part in the etiology. In one section the collargol is seen to be adherent to the intima of a vessel close to a pneumonic area. In 310, in which the pulmonary edema was the cause of death, the collargol was, we believe, an irritant. In 327 (Fig. 6) the lung showed numerous hemorrhagic infarcts directly around the collargol deposits in the lung. From the constancy of our findings, there can be no doubt of the direct causal relation of the collargol to all of the acute pulmonary changes.

Experiment 336: Injection of 20 c.c., 10 per cent. collargol directly into the iliac vein. This experiment was to determine whether a substance like collargol would cause death, as in 304, when injected directly into the systemic circulation. The dog died in four minutes; respiration stopped before the heart did. The lungs presented almost the same appearance as in 304, and also a large hemorrhagic infarct. All of the viscera and the blood in the vessels contained the collargol. Sections taken from the lungs showed innumerable blood-vessels (Fig. 7) filled with collargol emboli, as in 304. The vessels of the liver were also filled with the collargol (Fig. 8). This experiment corroborates our 304, showing that death can be caused by the collargol obstructing so many pulmonary capillaries that respiration is impossible.

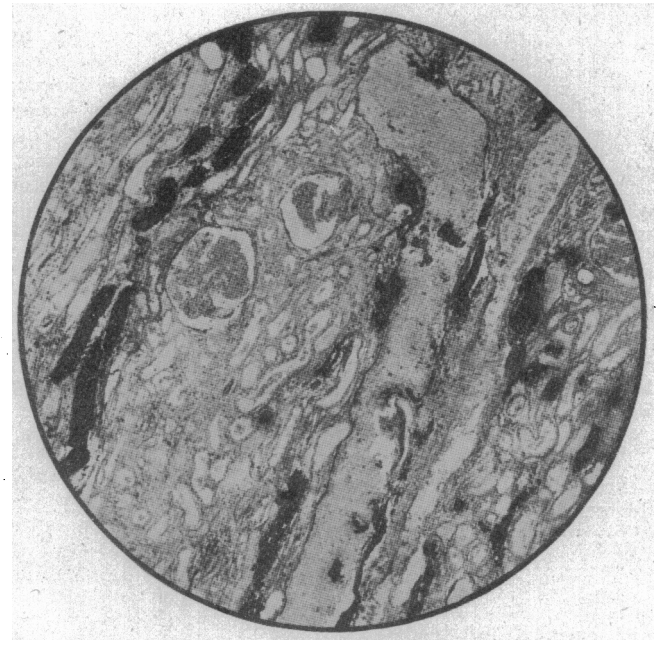

Fig. 10.—Kidney from Experiment 329, showing collargol breaking into vessel.

The occasional clinical use of stronger solutions of collargol led us to inject 20 per cent. collargol in Dog 329. The results were the same as when the weaker solution was employed. The animal died twenty-four hours after 37 c.c. had been injected at 140 mm. pressure. The tubules and glomeruli were filled to an even higher degree (Fig. 9) than in Series 3. In one of the sections the collargol could be seen entering the vessel and lying within it (Fig. 10). Death was due to acute pulmonary edema, and there was much collargol in the interlobular septa, as well as in the liver and spleen.

Series 4.—Cargentos used instead of collargol.

To see how other silver salts which have been recommended as substitutes for collargol would act, we injected cargentos, which contains 50 per cent. silver, into three dogs. In Experiment 326 the animal died twenty-four hours after 17 c.c. of a 10 per cent. solution had been injected at 140 mm. The tubular deposits and large infarcts (Fig. 11) appeared in the same manner as with collargol, and in addition there was a marked inflammatory reaction. The spleen, liver and lungs showed many hemorrhagic areas, and there was a well-marked pneumonia. In Experiment 334 the dog died on the fourth day after 6 c.c. of a 25 per cent. solution had been injected at 80 mm. The pneumonic changes were even more advanced than in 326. In 333 the dog died twenty minutes after 14 c.c. of 25 per cent. cargentos had been injected at 100 mm. In addition to the cargentos forming perfect casts of the urinary tubules (Fig. 12), the lungs contained much of the cargentos.

Series 5.—Collargol injected into kidneys in which experimental hydronephrosis and infection had been produced.

Experiment 327: 20 c.c. of 10 per cent. collargol at 196 mm. injected into ureter of hydronephrotic kidney of three weeks' duration. Animal died in ten minutes. There was a large hemorrhagic infarct in the lungs, and in sections much collargol was found in the lungs, especially near the infarct (Fig. 13). The kidney showed a few collargol streaks, but sections revealed the fact that the tubules and interstitial tissue had resisted the entrance of collargol far better than a non-hydronephrotic kidney. There was comparatively little collargol in the tubules or between them. In Experiment 331 an experimental hydronephrosis and ascending infection had followed implantation of the ureter into the bowel, and injecting its proximal end eighteen days later with 40 c.c. of 10 per cent. collargol at 140 mm. pressure. Animal died twenty-four hours later. Here, again, the kidney resisted the collargol better than a normal one, and the parenchyma contained only a relatively small amount of the fluid (Fig. 13). There were many hemorrhagic infarcts in the lung and pneumonic areas. There was a little collargol in the lungs, liver and spleen.

Series 6.—Methylene blue used instead of collargol.

We thought that neutral substances like 10 per cent. methylene blue might cause the same changes and verified this by injecting it in the same quantities and at similar pressures as were used with collargol and cargentos. The animals died within from five to twenty minutes, and the hemorrhagic infarcts and embolic plugging of the pulmonary vessels resembled in every way those observed with the silver salts.

COMMENTS ON EXPERIMENTS

In Series 1, in which the amount of collargol injected did not exceed the capacity of the renal pelvis, and only enough pressure was used to distend it lightly, practically no deposits in the kidney occurred, and no damage to its epithelium. When the pressure and quantity were increased, as in Series 2, the collargol was found more constantly, either in the kidney or lungs, or both. In 314 it was found in the blood-vessels of the kidney. In animals which lived for some days there was ample evidence that some irritant had been present, and had been the cause of an

intense inflammatory reaction. The more severe effects which collargol and cargentos can cause in both normal and pathologic kidneys are well shown in the remainder of the experiments. There can be no doubt that when more fluid is injected than the renal pelvis can hold, or it is injected with too much force, then the tension within the renal pelvis rises to such an extent that the fluid, whether it be collargol, cargentos or methylene blue, or any other substance sufficiently concentrated, is forced into the interstitial tissue and tubules, and soon breaks into blood-vessels and is carried by the veins to the lungs, and produces either embolism with immediate death, or an acute pulmonary edema, hemorrhagic infarct or a pneumonia. The photomicrograph shown in Figure 12 illustrates how the collargol is forced into the vessels and carried to distant parts. If carried to the liver, spleen, brain and other organs, the collargol is either deposited in the parenchyma or causes infarcts or hemorrhages.

The experimental work of Strassman and Wossidlo will be discussed in detail when this paper is published in full. Rehn's investigations have been published only in a preliminary form. The experiments of these three surgeons were all performed without taking into consideration the question of the pressure with which the fluid was injected. This, as we have attempted to show, is the key to the entire question. In other words, *collargol will not injure either the healthy or diseased kidney if care be taken not to inject more than the renal pelvis can hold.* If this limit is exceeded, or the fluid injected with too much force, serious results may follow, such as (*a*) larger (infarcts) or smaller deposits in the kidney and perirenal or perinephritic tissue; (*b*) infarcts or deposits or hemorrhages into the spleen and liver, and (*c*) various lung changes, such as embolic plugging of the vessels, hemorrhagic infarcts, acute pulmonary edema or pneumonia.

The use of collargol and cargentos in pyelography does not deserve to be condemned. They are perfectly safe aids to a most valuable method of diagnosis, when employed with care. Our experiments clearly show the dangers of injecting any fluid, even concentrated methylene blue, into the renal pelvis when too great a quantity and too much pressure are employed.

30 North Michigan Avenue.

ABSTRACT OF DISCUSSION

DR. W. F. BRAASCH, Rochester, Minn.: Dr. Eisendrath has certainly shown conclusively that collargol or any other solution of colloidal silver, when injected with pressure, can destroy the kidney tissues. In some two thousand clinical cases in which we have employed pyelography, I am not aware of having caused any damage to the kidney by means of overdistention. Any possibility of such danger is obviated by the gravity method. As Dr. Eisendrath has emphasized, if one does not use too much pressure there is no reason why any trauma or destruction of the kidney tissue should follow the injection of the solution. It has been my experience, however, that we do have trouble in certain cases when the injected silver is not drained out afterward. I have seen necrosis in four cases of hydronephrosis in which the collargol did not drain and the contraction of the pelvis forced the collargol up into the tubules and caused focal necrosis. All of these kidneys were primarily surgical, and their removal would probably have been necessary. Undoubtedly this is a source of danger. Therefore, we should take care not to inject in any case of hydronephrosis in which the injected solution cannot drain afterward and whenever the diagnosis can be made without a pyelogram. In following out a series of experiments on dogs along this line recently, Dr. Mann and I have injected different preparations of colloidal silver into the pelvis and ligated the ureter a short distance below. We found that focal necrosis will result in the parenchyma in practically every case. The various colloidal preparations all act in about the same way. In search for a harmless substance we also employed an emulsion of silver iodid, 5 per cent., and in seven dogs injected with this we found no evidence of focal necrosis. The great objection to silver-iodid emulsion, however, is that it has to be used with a syringe, since it is too viscid to employ by the gravity method. Pyelography is not to be employed with impunity, and should be used only in selected cases. Its use is only excused when the diagnosis cannot be made without it. If we carefully select our cases, and do not use colloidal silver in conditions in which it cannot drain after injection, and if we use the proper technic, there is no reason why an experienced cystoscopist should have serious consequences from pyelography. I believe, however, that we should continue our search for a harmless preparation which could be employed more generally.

DR. A. J. CROWELL, Charlotte, N. C.: I was glad to hear Dr. Braasch say that we ought to search still further for a drug that would be less harmful to the kidney in pyelography. I disagree with Dr. Eisendrath that silver or collargol is not dangerous. I had, about two months ago, the misfortune to lose a patient on whom I used collargol. The patient was referred to me for a roentgenogram and then for ureteral catheterization and collargol injection for diagnosis. When the patient was admitted to the hospital a picture was immediately taken for kidney stone, which proved to be negative. This patient gave kidney symptoms. The ureters were catheterized. The urine coming from the right ureter was perfectly clear and came away intermittently. That from the left was continuous and cloudy, which condition was afterward proved to be caused by pus, and a few tube casts were found, both hyaline and granular. The catheter in the right ureter was removed after it had remained for two or three minutes. About 3 ounces of urine had been withdrawn from the left kidney—in fact, the catheter was left in until the urine came away intermittently. I estimate that at least 1½ ounces of urine was secreted during this time. Therefore, I had no hesitancy in injecting into the pelvis of that kidney 12 c.c. of a 10 per cent. solution. This was injected with a syringe, but very slowly, and on the first indication of discomfort the patient was instructed to notify us, which she did, and the picture was taken immediately. The catheter was left in for ten minutes at least, for two reasons: first, to allow the collargol to return, which it did very readily; secondly, to allow the time for the development of the roentgenogram. The picture was reported all right, the catheter was removed, but the patient suffered such excruciating pain that it became necessary at once to give a hypodermatic of morphin. She was taken care of as best we could by various remedies for the relief of the pain and to overcome shock. She remained a very sick woman until the fifth day when she died. There was almost complete suppression of urine from the very beginning. The greatest quantity of urine secured as ascertained by catheterization in any twenty-four hours was 3 ounces. I was unable to secure a complete post-mortem, but obtained the kidneys. Finding collargol in the opposite kidney of this patient, suggested trying experimental work on dogs to ascertain the distribution of the drug. I injected 10 c.c. into the pelvis of the right kidney of one dog and 5 c.c. into the right kidney of another. I injected 10 c.c. into the kidney pelvis of one and it died in five minutes. The other we killed in two days. We found collargol in the lungs, kidney, liver, spleen and muscles of the heart. I have no specimens of the patient who died, save from her kidneys, but why she should die from suppression of urine when only one kidney was injected is a question. Post-mortem examination showed the capacity of the woman's kidney to be 1½ ounces. I injected only 12 c.c. of the solution, so it was not full. On

the second or third day after the injection she developed symptoms of purpura. Even where she was given hypodermatic injections, there was an extravasation of blood under the skin. She suffered considerable hemorrhage from the mouth and bowels after the second or third day.

DR. F. R. HAGNER, Washington: I saw in consultation a case in which a 25 per cent. argyrol solution had been used. This was done by Dr. G. Brown Miller of Washington, an able gynecologist. He assured me that he put in less than 8 c.c. of argyrol. This woman was about 70 years of age and was supposed to have a tumor of the kidney. Immediately after the injection she complained of discomfort and pain in the precordial region. For twenty-four hours she had practically complete suppression of urine. In the next twenty-four hours she excreted approximately 16 ounces. About the third day she began to pass blood by the bowel, her stomach became very much distended, a stomach-tube was passed and her stomach was found filled with blood. She had hemorrhages from the gums, nose, and blood in the urine and petechial hemorrhages over the entire body. When I saw her I suspected she might have mercuric chlorid poisoning. It looked like a case of metallic poisoning. Has any one seen any symptoms of metallic poisoning in any of these cases in which the colloidal silver salts have been used? We were unable to get a necropsy in this case.

DR. H. D. FURNISS, New York: I had a patient who gave much the same history as the patient reported by Dr. Hagner. She was injected with collargol, and within a few minutes she had an immense amount of pain. Following that the condition cleared up, but on the third day I explored the left kidney and found an anomalous blood-vessel running to the lower pole. Three days after the operation and five days after the injection the patient had suppression of urine, which lasted for eight days, and during that time there was no more than 1 ounce excreted in any one day. At the end of that time I decapsulated the right kidney. I was afraid of getting too much hemorrhage from the side I had previously operated on. Within twenty-four hours after the decapsulation urine began to be excreted, and was excreted in fairly good amount for the next four days, at the end of which time she died; but after the operation this patient had hemorrhages from the nose and mouth, just as Dr. Hagner has reported. Collargol is sometimes used therapeutically intravenously, in a percentage which is a solution. In these cases in which it is injected into the kidney it is in the form of an emulsion, and it has struck me that that probably accounts for the emboli that are found.

DR. MARTIN KROTOSZYNER, San Francisco: I made an observation similar to that of Dr. Hagner in a woman of about 40, who after injection of a small amount of a 20 per cent. cargentos solution developed symptoms similar to those described by Roessle, and which this author considered to be due to an acute silver toxemia or argyria. I cannot share Dr. Eisendrath's optimism regarding the avoidance of all dangers connected with pyelography by regulating the pressure in injecting the silver salt. Shortly before leaving home I injected in a man of 45, with a unilateral pyuria of doubtful character, under very low pressure, 2 or 3 c.c. of a 10 per cent. collargol solution. In spite of the utmost precaution in the procedure and in spite of discontinuing the injection at the first sign of discomfort on the part of the patient, the exposed kidney presented a focus on its capsule which was proved by the pathologist to be due to penetration of collargol through the renal tubules. This observation and similar ones recorded in the literature by others prove that the last word on the cause of pyelographic mishaps is not yet spoken. It is to be hoped, though, that the dangers of pyelography will be avoidable so that this important diagnostic method, which we would not like to dispense with in our armamentarium, will not become entirely discredited.

DR. FREDERICK R. CHARLTON, Indianapolis: I report a death from collargol. This patient had a tumor mass (necropsy was not obtained) perhaps the size of a small grapefruit, supposedly hydronephrotic. This was a year ago, before the danger of using a piston syringe was so fully understood. We injected 15 c.c. of a 25 per cent. collargol solution. Before the injection was completed the patient was complaining of distress. I waited for a moment until he was easier, and then continued the injection until I had injected the full 15 c.c. I labored under the impression at that time that perhaps it would be somewhat difficult to get a dangerous pressure from that amount of fluid, feeling that a certain percentage of it would find its way backward down the course of the ureter along the catheter. That belief does not seem to be borne out by later experiences. We took our roentgenogram, getting an excellent one, showing extravasations of collargol well out toward the cortex and outlining a large mass of some kind. Our patient went into collapse and died in eight hours. This man had walked into the Roentgen-ray laboratory, so that the case was a distressing one, and we could not get a necropsy for obvious reasons. I felt at the time that perhaps it was due more to cardiac collapse than anything else. Granting that I had produced some small rupture in the pelvis, I could not see why that should cause immediate death. I did not feel at the time that collargol was to be regarded as dangerous from the point of view of its drug properties. And so in trying to explain my patient's death I felt that perhaps we had a bad myocardium, that I had produced just enough pain to cause considerable shock, and that his heart had not been able to rally after such shock.

FRACTURES OF THE INFERIOR MAXILLA

A REPORT OF 1,065 CASES TREATED*

HENRY S. DUNNING, M.D., D.D.S.
NEW YORK

During the last eight years I have had quite an opportunity of studying fractures of the maxillary bones at the New York College of Dentistry. At the college we have a large daily oral surgery clinic under the direction of Prof. Faneuil D. Weisse and myself, which is fed by the outpatient department of nearly all of the large hospitals of Manhattan. Since the founding of the oral surgery clinic at the college in 1906, we have treated over 1,200 fractures of the inferior maxillary bone, but I am sorry to say that at this time I can present figures taken from only 1,065 cases, as some of the records are not very complete.

Stimson says, "By fracture, in the surgical sense, is meant the breaking of a bone or cartilage." The liability of a bone to fracture depends on its shape, size and degree of exposure to external violence or trauma, and also to its exposure to extreme muscular action. On account of its peculiar horseshoe shape, its prominence and its unsupported position, and the fact that it is somewhat weakened by the carrying of teeth that often become diseased, the inferior maxillary bone is the most frequently fractured bone of the face.

Stimson shows that in 14,566 fractures of all the bones of the body treated at the Hudson Street Hospital (1894-1905), 502 of these were fractures of the inferior maxilla. From his figures this bone is the tenth on the list as being most often fractured. Another reason for its frequency to fracture is its weakened condition because of physiologic absorption after teeth are extracted. Most fractures of the body of the bone proper, or of the rami, are complete fractures, and it is the complete fractures that will be discussed to-day.

---

* Read before the Section on Stomatology at the Sixty-Fifth Annual Session of the American Medical Association, Atlantic City, N. J., June, 1914.

* Because of lack of space this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.