The general character and quality of the work done in each of the three departments are regularly inspected and reported on by the members of the advisory committee.

ABSTRACT OF DISCUSSION

DR. JOHN OSBORN POLAK, Brooklyn: This paper shows what may be accomplished by the combination of obstetrics and gynecology under one head. By combining these two departments the service rendered is improved and fundamental pathology in women becomes better understood, which entitles us to recognition even from the general surgeon. Dr. Holden has presented the organization in a city hospital, and in our organization at the Long Island College Hospital we have the same general plan of one head, controlling both departments, a resident and an intern staff. From my experience of twenty odd years, hospital obstetrics cannot be well done without the assistance of trained help. The intern after two or three months of obstetrics does more harm and as bad work as the ordinary practitioner. With the resident system well developed one can keep his men for from two to five years and give them sufficient work to train them. These men gradually supersede the assistant visiting staff. The routine work is taken off of the shoulders of the attending physician, yet the responsibility is placed with him because he has to check up everything that is done. These men go from these institutions and develop better obstetrics and better gynecology in other places. It has been a most illuminating experience to see what the proper development of residents in obstetrics and gynecology will do for a service. We had a service for nearly twenty years which did not run above 300 cases a year. Since the introduction of the resident system some six years ago the cases have increased from 300 to 1,500 a year. Under this system these residents work in the dispensary, follow the case to the hospital and have operative privileges under the direction of the chief.

DR. CHARLES S. BACON, Chicago: It is interesting to observe how rapidly patients are going to the hospital for confinement. In several of the large city hospitals from one eighth to one fourth of all the beds are taken by obstetric patients. In the description of the hospital given by Dr. Holden two things seem to be lacking. One is an arrangement for teaching students. That the hospital should not be made use of for medical students is a great pity. They could obtain so much benefit and be of so much use to the hospital. Another thing which is lacking is provision for research work. The laboratory in such a hospital ought to be under the control of the obstetrician and his resident and there should be ample provision for laboratory work.

DR. HENRY P. NEWMAN, San Diego, Calif.: We should congratulate students who are privileged to profit by such instruction, but it must be recognized that, in order to fit one for the practice of obstetrics as a specialty, and the same is true of gynecology, requires, as a paramount essential, a much wider experience, a more thorough working knowledge of the intricacies of complicated cases, and a more intimate understanding of the individual patient than can be obtained in the class room or from textbook formulas.

DR. FREDERICK C. HOLDEN, Brooklyn: We have senior medical students who act as clinical clerks. They come in groups of six for three months, one month in each of the three departments. The second floor of the laboratory building has five large rooms used for pathologic work and animal experimentation. We have a paid resident pathologist and his work is supervised by an attending pathologist. There is also a large clinical laboratory on the fourth floor of the hospital where urine, blood, etc., are examined. We secured necropsies in 50 per cent. of our fatal cases. The building and equipment cost approximately $900,000.

Loss of Life in War.—The human loss sustained by a military power in a war may be caused by the weapons of the enemy, by disease and pestilence, privation, and hardship, physical exhaustion, capture and imprisonment by the hostile nation, and finally, by desertion.—Bodart.

ANESTHESIA IN HUMAN BEINGS BY INTRAVENOUS INJECTION OF MAGNESIUM SULPHATE *

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In this preliminary communication we wish to report briefly the course of anesthesia in three operations performed on human beings exclusively under the influence of an intravenous injection of magnesium sulphate. The object of this report is, at least for the present, essentially a theoretical one. These few observations, although far from being sufficient to demonstrate the practicability of this method of anesthesia, are completely sufficient to establish the theoretical question regarding the nature of the anesthesia produced by magnesium sulphate. Furthermore, the theoretical information thus obtained is an indispensable step in the development of the practical application of this method. In order to understand the question under discussion, a brief historical statement of the various phases in the progress of this investigation is necessary.

In a series of experiments on the effects of intracerebral injections of solutions of various salts carried on some eighteen years ago on rabbits by one of us, it was observed that an intracerebral injection of 2 drops of a 5 per cent. solution of magnesium sulphate produced complete anesthesia and relaxation of the animal lasting several hours. On the basis of the hypothesis that magnesium is an inhibitory factor in the life phenomena, this observation led to a prolonged experimental study of the effects of magnesium salts on the animal body and to many publications on this subject. In their first publication in 1905, Meltzer and Auer made the general statement that the salts of magnesium are capable of depressing the entire nervous system, and assumed in particular that these salts are also capable of producing anesthetic and other central effects. Since this first publication, quite an extensive literature grew up on the subject. Some of the writers insisted that magnesium exerts only a curare-like action, that is, the salts paralyze the motor nerve endings to such a degree that the animal is incapable of responding to any stimulation; in other words, that the animal which appears to be anesthetized is actually conscious during the operation and feels all the pain inflicted on it, but is incapable of manifesting its sensations on account of the complete paralysis. Against this assumption it is to be mentioned that in the course of their experimentation on animals, Meltzer and Auer found, among others, that a combination of ether inhalation and intramuscular injections of magnesium salts, in small ineffective doses, produces a profound anesthesia. Peck and Meltzer found this to hold true also for human beings. Since the amount of ether used in these cases was absolutely insufficient to produce anesthesia, the additional effect of magnesium is apparently of central origin. While thus these observations made the assumption of the central action of magnesium highly probable, it could not be claimed that it has definitely proved it for reasons which cannot be discussed here in detail. Studies of Auer and Meltzer on the effect

* From the Roosevelt Hospital and the Rockefeller Institute.

of intravenous injection of magnesium sulphate on the various stages of the action of the center of deglutition seemed to prove definitely that magnesium affects the center of the deglutition. While these observations seem indeed to prove definitely the central nature of the action of magnesium salts, it could still be assumed that the fact that magnesium salts affect some parts of the central nervous system cannot serve as evidence that these salts affect also the sensation of pain and the consciousness.

Evidently a reliable proof for the assumption that magnesium is capable of abolishing consciousness can be obtained only from observations on human beings. Intravenous injections of magnesium sulphate into human beings were made about a year ago in several cases of tetanus. Whether or not the consciousness of the patients was affected could not be learned from the meager descriptions of these cases. At any rate, these cases have the merit of the demonstration that certain amounts of magnesium sulphate can be given intravenously to human beings without endangering their life. Furthermore, in two or three of the cases the amount injected was surely not too small. In a recent series of experiments on intravenous injections of magnesium sulphate into dogs, Auer and Meltzer studied the quantity of magnesium which may be introduced without danger to the animal, and which would, at the same time, be capable of producing apparently profound anesthesia.

From the recent extensive experience on the use of magnesium sulphate in cases of tetanus, we gained the general impression that human beings are more susceptible to the effects of magnesium salts than animals. In trying to study the anesthetic effect on human beings of magnesium sulphate, administered intravenously, it was therefore necessary that the observations should be made with great caution, beginning with injections of only small doses. The dose of magnesium sulphate used in our first case was much smaller than some of the doses used for many hours with apparent impunity by Straub in his tetanus cases. We may add, further, that in our studies the patient was provided with two reliable safeguards against the prominent toxic effect of an overdose of magnesium salts (that is, respiratory paralysis): we had in readiness an apparatus for administering efficient artificial respiration, and had on hand a proper solution of calcium chlorid to use as a prompt antidote for the restoration of respiration.

OPERATIONS

The patients were prepared for the operations in the usual way, except that they did not receive the usual preliminary injection of morphin. In all three cases the cubital vein was exposed and a transfusion needle inserted directly into it. This preliminary slight operative procedure was done under local anesthesia. The magnesium solution was run into the vein through the transfusion needle from a graduated buret arranged on the principle of Mariotte's flask. The number of bubbles appearing in a unit of time at the lower end of the inner tube permits a general estimation of the rapidity of the infusion. This, however, was more reliably controlled by frequent reading of the quantity of magnesium which escaped from the buret in one or two minutes at a time.

CASE 1.—March 30, 1916, G. F., Italian, weighing about 160 pounds, was operated on for glandular abscess in the neck. A 6 per cent. solution of magnesium sulphate was used in this case. The infusion began at 4:29 and was finished at 5:14 p. m. Altogether 180 c.c. of the solution were infused in forty-five minutes, 80 c.c. of which, however, were infused in the course of the last eleven minutes, which means at an average of 8 c.c. per minute. Shortly after the infusion was started, the patient began to complain of feeling hot; his face became very much flushed, and his forehead was covered with beads of perspiration; there was no nausea. At 4:45 the pulse was 104, and respiration 28 per minute. At 4:56 the pulse was 120, respiration 32. At 4:59, pulse 100, respiration 36. At 5:04, pulse 100, respiration 28. At 5:07, pulse 112, respiration 20. At the end of the infusion, pulse 112, respiration 28.

The operation was began at 5 p. m. The patient was fully conscious, but sensation was considerably diminished. He made no attempt to interfere with the operation. During the last seven minutes of the operation, the patient showed no indication of feeling pain, and manifested only slight signs of consciousness. The lid reflex was prompt. He remained very drowsy for about fifteen minutes after the operation. He responded slightly to loud calling. He said that he felt weak.

Twenty minutes after the operation the patient was fully awake. He said that he felt a "little bit of pain" during the operation. He was very thirsty, and had a glass of ice water. He had no nausea. There were no after-effects of the anesthesia, and the patient made an uneventful recovery.

During the last part of the operation the patient was practically under complete anesthesia and had evidently no knowledge of what was happening to him. His later statement that he felt a "little bit of pain" referred to the first incision. Respiration and lid reflexes remained practically unaffected. While there was later some muscular weakness which may have had its origin in the action of the magnesium on the endings of the motor nerves, this peripheral action was evidently far behind the inhibitory action which the infusion of the magnesium solution exerted on pain sensation and consciousness. At any rate, even this case clearly demonstrated that the magnesium solution exerts a genuine central effect which is entirely independent of any peripheral action which may or may not be present.

Considering the weight of the patient, it must be emphatically stated that he received a very small dose of the salt, a dose which would be absolutely insufficient to produce a similar effect on an animal. A dog of 10 kg. (one eighth of the patient's weight) which would receive 23 c.c. of the same solution (about one eighth of the solution given to the patient) in the course of forty-five minutes would hardly show any depressive effects.

CASE 2.—May 2, 1916, A. S., weighing 120 pounds, was operated on for varicocele. The infusion of a 6 per cent. solution of magnesium sulphate was begun at 4:20 p. m., and terminated at 5:08 p. m. In forty-eight minutes, 394 c.c. were infused. The average of velocity of infusion was 8.5 c.c. a minute. From 4:46 to 5:05, however, 235 c.c. were infused, which is at an average of 12.4 c.c. a minute. Furthermore, in the one minute from 5:04 to 5:05, the large quantity of 39 c.c. was infused. In the following last three minutes altogether only 13 c.c. were infused. This patient also complained of heat, and his face became flushed and the forehead was covered with perspiration. The patient vomited at 4:46. During the entire infusion the lowest pulse rate was 108 a minute. At 4:58 the patient began to feel sleepy. The first incision was made at 5:00 p. m. At 5:02 the patient was still moving and slightly groaning, but did not interfere with the operative procedure. Anesthesia soon became very deep. At 5:06 respiration was shallow and only 6 per minute. The rate of infusion of magnesium was greatly reduced; respiration immediately became deeper and more frequent, about 22 per minute. At 5:08 the magnesium infusion was stopped completely. The operation was completed at 5:13. In the

last five minutes of the operation the patient had no infusion of magnesium solution. At 5:15, 10 c.c. of a 2.5 per cent. calcium chlorid solution were infused. There was no need for it, as the respiration was fairly good, but the injection of the calcium solution deepened the respiration visibly. At 5:19 the patient answered questions. He opened his eyes at 5:20 and was apparently fully awake. He stated that he felt no pain whatsoever during the operation. He was very thirsty, and had two glasses of ice water. No nausea or vomiting followed. There was no special after-effect from the magnesium infusion. He passed urine spontaneously and freely which was free from albumin, casts, sugar, acetone and diacetic acid. Twenty-four hours after the operation the patient began to complain of pain in the wound. The temperature rose gradually to 103 F. Pain and high temperature soon disappeared, however, and the patient made an uneventful recovery.

In this case consciousness and sensation were completely abolished for at least ten minutes. The patient had no recollection whatsoever of the operative procedure. The short but very rapid infusion of the solution at a rate of 39 c.c. in one minute affected considerably the rate and depth of the respirations, but a reduction in the rate of the infusion caused quickly a return of the respiration to practically normal conditions.

CASE 3.—May 26, 1916, H. P., weighing 125 pounds, was operated on for double inguinal hernia. The magnesium sulphate was given in this case in a 10 per cent. solution. Infusion was begun at 4:23 and finished at 5:14; 280 c.c. were infused in the course of fifty-one minutes, that is, at an average of 5.4 c.c. per minute. However, between 4:39 and 4:52, that is, in thirteen minutes, 169 c.c. were infused, which is at an average of 13 c.c. per minute. Between 4:52 and 5 o'clock the infusion was stopped. From 5, when the infusion was resumed again, to 5:14, when it was finally stopped, only 20 c.c. were infused, that is, at an average of about 1.5 c.c. per minute. After about 30 c.c. were infused, the patient began to feel hot, was perspiring and became restless. When about 63 c.c. were infused, the patient stated that he felt weak. At 4:25 (15 c.c.), the pulse was 120, and respiration 22 per minute. At 4:33 (57 c.c.), pulse 120, respiration 16. At 4:45 (143 c.c.), pulse 96, respiration 24; the operation was started. At 4:47 (182 c.c.) *the anesthesia was very deep; there was no spontaneous respiration; artificial respiration by pharyngeal insufflation was begun.* At 4:50 the pulse was small, 96; the patient pale and slightly cyanotic; the pupils slightly dilated and fixed. At 4:52 the magnesium was stopped. From 4:47 to 4:56, for nine minutes, there was no sign of a spontaneous respiration. At 4:56 occasional spontaneous respirations appeared. At 4:58 spontaneous respirations were regular, 20 a minute; the pulse was 90 a minute and bounding. At 5 o'clock the patient's color was good, respiration regular, pulse 120. Magnesium was started again. At 5:03 the lid reflex was still absent; pulse 112, respiration 22. At 5:06 the lid reflex was coming back. At 5:08 the pulse was 118, respiration 20. At 5:10, pulse 100, respiration 22. At 5:13, pulse 96, respiration 26. At 5:14 magnesium infusion was stopped. At 5:21 the operation was finished; the pulse was 108, respiration 27. At 5:31 the patient opened his eyes when spoken to.

He was conscious on return to the ward, very thirsty, and was given 6 ounces of water in ten minutes. There were no nausea and no vomiting. *The patient asked whether he had already been operated on.*

On the second day after operation the patient complained of abdominal pains; the abdomen was moderately distended and rigid. The temperature rose to 102.4 F. The patient was about normal again on the third day, and recovery was uneventful.

In the two days following the operation the urine showed a trace of albumin and many hyaline casts, but no sugar.

During the infusion of the magnesium solution the patient was completely unconscious for about forty minutes; when he came out of the anesthesia he had no recollection of the events of the operation. For at least ten minutes there was no spontaneous respiration; the respiratory function was then maintained exclusively by artificial respiration (pharyngeal insufflation). Under the magnesium anesthesia the lid reflex was absent for about twenty minutes. For a few minutes the pulse became slow, and for from ten to fifteen seconds it was even irregular and at times imperceptible. It is possible that with the concentration used in this case (10 per cent.) the magnesium solution may exert also a cardiac effect. This concentration, therefore, ought not to be used until we have learned more of the effects of magnesium sulphate on human beings when used intravenously.

SUMMARY

The observations made in these cases prove conclusively that the state of anesthesia which is produced by injection of magnesium sulphate is actually anesthesia, that is, in this state sensation as well as consciousness are temporarily more or less completely abolished. This central effect may or may not be accompanied by a pronounced paralysis of the endings of the motor nerves of a great part of all skeletal muscles. Evidently, the central effect, especially the effect on the sensation of pain and on consciousness, can be attained with a smaller dose of the magnesium salt than that which is required for a paralysis of the motor nerve endings. The central effect also appears to set in sooner than the peripheral one.

The employment of intravenous injection of magnesium salt as an anesthetic may prove to be indeed a practicable and advantageous method, because, in the first place, it may cause simultaneously a moderate degree of relaxation of the muscular mechanism, and, secondly, because the untoward effects can be rapidly reversed by a careful administration of a solution of calcium chlorid. This method, however, before it can be made practically serviceable, will require a good deal of careful study. We shall, therefore, at least for the present, abstain from a discussion of the possibility of the practical applicability of this method.

Venereal Diseases and Militarism.—Venereal disease is the cause of more hospital admissions among soldiers than any other disease or group of related diseases. It caused 31.8 per cent. of the total military inefficiency in the British army in 1910. It was the cause of one fifth of all the British military hospital admissions for that year, yet it caused but one one-hundredth of the total military deaths. It causes one third of all the illness of the British navy, both at home and abroad. In 1910 the navy force included 113,530 men, of whom nearly 15,000 were ill of venereal diseases. From 1865 to 1872 the hospital admissions of soldiers in the United Kingdom for venereal diseases averaged more than one case to every five men, in some years four men, in the army. In the fourteen years ending 1883, the average admission rate for the whole British army in India for venereal disease was 225 cases per 1,000 men. In 1895 these admissions reached the enormous proportion of 537 per 1,000 men. I hasten to add that this frightful condition has been greatly ameliorated. In 1900 there were but 295 cases per 1,000 men. But even this is nearly one for every three men! In very recent years the figures for the British army have been notably lowered. In 1908, for example, the lowest figures on record up to that time were reached. These were 76.8 hospital admissions per 1,000 men of total strength of the troops in the United Kingdom and Europe. From 1903 to 1907 the average admissions were 122.3 per 1,000 men of the whole army.—V. L. Kellogg.