

results on the whole are in accord with those of Cabot, who was unable with varying doses of alcohol to demonstrate in febrile patients a rise in blood-pressure.

The above results, like the animal experiments, impress us with the uncertainty of the reaction of the individual to alcohol; as even in small doses it may, and in large doses invariably does, depress the circulation. It is fair to assume that in these conditions drugs like camphor, caffeine and digitalis are of much more value, as they are more constant in their action and much less liable to affect the patient unfavorably.

SUMMARY

In the circulatory disturbances of the acute infections, impairment of the vascular regulating mechanism is more apparent than active disturbance of the heart, and therapeutic measures should be directed toward the prevention or correction of these vasomotor disturbances. Alcohol in man and the lower animals, when taken in small amounts, frequently acts as a cardiovascular stimulant. The exact method of action is still disputed. Larger amounts of alcohol in individuals not addicted to its use, invariably act as a cardiovascular depressant by paralyzing the vasomotor center. The border-line between the amount acting as a stimulant and the amount having a depressing action is variable, and this variability in action renders alcohol an undesirable therapeutic agent.

150 Michigan Avenue.

ABSTRACT OF DISCUSSION

DR. RICHARD CABOT, Boston: In the use of alcohol in these circulatory disorders there is the difficulty of knowing whether one is dealing with alcohol or with a variety of other substances combined with alcohol in the substance known as whisky. When I began to work with alcohol experimentally I tried to use absolute alcohol and it has been said that the use of absolute alcohol in connection with acute disease is advantageous. So far, I have been unable to get any considerable number of patients to take absolute alcohol, either diluted, flavored or in any other way. They objected so strongly that, in my hands, its use has been impractical. Therefore I have had to use that very uncertain mixture known as whisky and all my results in blood-pressure work with whisky have been, therefore, not properly attributable to the action of alcohol. If anyone has found any way in which he can so flavor absolute alcohol to make patients take it without objection I would like very much to hear of it.

DR. A. JACOB, New York: Alcohol is indicated in cases in which sepsis is imminent. There is no better antiseptic than alcohol, no purer antiseptic. I am satisfied with American whisky; it does my work. There are cases of sepsis from diphtheria, for instance, in which the patients may be saved by whisky. I speak of those cases of diphtheria so malignant from the beginning as not to be touched by antitoxin. In such cases no dose is too large; it is impossible to cause alcoholic intoxication until sepsis has disappeared. Alcohol is not indicated while active hyperemia prevails.

Differential Diagnosis of Chilblains and Lupus Erythematosus.—Chilblains may be confused with lupus erythematosus, which frequently attacks the hands but is seldom confined to that situation; true lupus erythematosus is also very liable to supervene in patients with chilblain circulation, a fact which has originated Hutchinson's term of "chilblain lupus." There is no vesication with lupus erythematosus; it is uncommon in young people who are the chief victims of chilblains; there is no retrogression of the eruption in warm weather, such as takes place in chilblains, and finally there will almost certainly be other patches of lupus erythematosus elsewhere.—E. G. Little, in the *Practitioner*.

MAGNESIUM POISONING

A STUDY OF TEN CASES *

WILLIAM F. BOOS, M.D., PH.D.

Chemist and Pharmacologist, Massachusetts General Hospital
BOSTON

INTRODUCTION

The salts of the Glauber salt group are characterized by the difficulty with which their solutions are absorbed from the gastro-intestinal tract. The most important members of the group are the sulphates of sodium and magnesium.

Both Glauber salt and Epsom salt are easily soluble in water. When these salts are taken into the system in dilute form their solutions pass through both the small and large intestines practically unchanged, because the tendency to absorption is so slight that under these conditions the solutions are virtually non-absorbable and because the salts prevent the absorption of any water which was used to dissolve them. Such solutions passing unchanged through the entire bowel produce their effect in part by simply washing out its contents and partly by their local irritant action on the intestinal wall.

In 1884 Hay¹ showed that the tendency to absorption of Glauber salt is increased by raising the concentration of the solution, and when, in the course of his experiments on animals (the intestinal tract of which was free from fluid) he gave the salt by mouth, he found that large quantities of the dry salt produced no catharsis whatever, while the same doses given in dilute solution invariably produced copious movements. The dry salt was gradually absorbed from the gastro-intestinal tract into the blood and was excreted by the kidneys.

Beginning with concentrated solutions of Glauber salt, Gummilewski² found that the addition of water steadily diminished the tendency to absorption. Continuing the dilution, he reached a point below which absorption was reduced to a minimum; from this point on there was practically no absorption down to solutions of 1 per cent. and less. With its slight tendency to absorption the dilute salt solution does not normally remain in the intestine long enough to allow an appreciable amount of the salt to be taken up; if, however, a Glauber salt solution cannot readily leave the bowel on account of mechanical obstruction, or because peristalsis is much diminished or absent, then even a dilute solution will undergo gradual absorption, and there will be no catharsis. In the normal bowel the degree of dilution of an active Glauber salt solution has no bearing on the efficiency of the catharsis produced, a 2 per cent. solution being as effective as a solution containing 5 per cent. of the salt, provided, of course, a sufficient quantity of the solution is given in each case.³

The question whether or not these salts by their presence in the intestine are capable of abstracting water from the system is still undecided, the experimental evidence on this subject being contradictory. According to Schmiedeberg⁴ it is very unlikely that such abstraction

* Read in the Section on Practice of Medicine of the American Medical Association, at the Sixty-first Annual Session, held at St. Louis, June, 1910.

1. Hay: An Experimental Investigation of the Physiological Action of Saline Cathartics, Edinburgh, 1884, Jour. Anat. and Physiol., 1883, xvi, 391 and 1884, xvii, 222.

2. Gummilewski: Arch. f. d. ges. Physiol. (Pflüger's), 1886, xxxix, 584.

3. Aubert: Ztschr. f. rat. Med., 1852, part 2, p. 225, Buchheim and Wagner: Arch. f. physiol. Heilk., 1854, xlii, 93.

4. Schmiedeberg: Grundriss der Pharmakologie, 1906, p. 413.

should take place under normal conditions. If it ever occurs, Schmiedeberg⁵ thinks, it will be most likely to happen when the system contains an excessive amount of water, as in cases of general edema, ascites, hydrothorax, pleurisy with effusion, etc. Certain experimental work which I have done on this subject is corroborative of Schmiedeberg's theory. The results of these experiments are to be published in a later paper, together with the results obtained from a quantitative experimental study of the absorption of Epsom salt given in varying concentrations.

The medical literature gives no information concerning the conditions governing the absorption of magnesium sulphate from the gastro-intestinal tract, but the histories in the cases of poisoning by the internal administration of Epsom salt and the results I obtained in my experiments both give evidence to the effect that magnesium sulphate closely resembles sodium sulphate in every particular relating to its behavior after ingestion. Theoretically, therefore, we should expect to find that concentrated solutions of magnesium sulphate are absorbed in part from the stomach and intestines into the circulation, and that when a sufficient amount of magnesium is present in the circulating blood at any one time magnesium poisoning will result.

When magnesium salts are injected into the blood of animals a very characteristic intoxication is produced.^{6, 7} The pulse, at first somewhat accelerated, soon becomes slower and slower, until the heart stops in diastole shortly after paralysis of the respiration. The respiration is affected from the start. The reflex irritability is lost twenty minutes after the beginning of the injection and it may still be absent for an hour and a half after respiration has returned to normal. The peripheral motor nerve endings are paralyzed, but where recovery occurs voluntary movements return long before reflex irritability is restored; 0.3 to 0.5 gm. per kilo body weight, given intravenously, produces death in dogs. Subcutaneous application produces qualitatively the same symptoms, but much larger doses are necessary to cause death. On section of the animals Recke⁷ found subpleural ecchymoses and extravasation of blood into the pleural cavities.

The work of Meltzer⁸ seems to indicate that magnesium salts may produce intoxication through cumulation. I, too, have found the excretion of magnesium sulphate through the kidneys to take place so slowly that if small doses of Epsom salt in concentrated solution are given at short intervals cumulative poisoning may result.

If magnesium absorbed into the blood in sufficient quantity was the cause of intoxication in the cases I shall describe we may expect these cases to show symptoms and autopsy findings resembling those obtained in animals by the intravenous application of magnesium salts.

Of the ten cases which I shall discuss, reports of seven are to be found in the literature; two of the other three cases I have observed personally; the report of the third case I obtained from the records of the Massachusetts General Hospital.

REPORT OF CASES

CASE 1.⁹—J. A., 31, Italian, married, second pregnancy, was brought to the hospital on January 22 with a history of having had no movement of the bowels for three days. The patient looked very sick, her respirations were slow and labored, but both the temperature and pulse were only 100. From time to time she vomited yellow watery matter. The uterus, at full term, lay in the right side of the abdomen; it contracted regularly every ten minutes. The left side of the abdomen was puffed up by a distended intestine; there was no visible peristalsis. The examination of a catheter specimen of urine showed the following: Quantity 125 c.c., specific gravity 1.080, no albumin, no sugar. Two glycerin enemata low were given without result. An oil enema gave result from lower bowel. A high turpentine enema gave a good result, relieving the distention. Operation was done for removal of an ovarian cyst. In the urine, which was submitted to me for examination, I found a total of 0.6620 gm. of magnesium, calculated as oxid, and corresponding to 1.95 gm. of magnesium sulphate.

It was impossible in this case to obtain a history of the patient before entrance. Undoubtedly she had been given Epsom salt by her physician, but on account of obstruction of the bowel by the ovarian cyst the salt solution was not permitted to pass out of the intestine; consequently absorption of magnesium sulphate took place. After absorption into the blood the Epsom salt tended to increase the obstipation by paralyzing the bowel.

CASE 2.¹⁰—H. M., 60, chore-man. Diagnosis, chronic bronchitis and emphysema with acute exacerbation; chronic myocarditis.

Patient on entrance passed 30 to 35 ounces of urine, the examination of which gave the following: Odor and color normal, acid, specific gravity, 1.022, albumin, slightest possible trace, sugar absent, no casts. April 14 to 15, the urine rose to 2,940 c.c.; on April 17, it fell to 1,860 c.c., and on April 18 to 480 c.c. On April 14 magnesium sulphate, 1 ounce in concentrated solution every morning was ordered.

April 16, the patient was much more comfortable as a result of rest in bed. He ran an irregular temperature, normal in the morning and up to 101 F., in the afternoon. There were many moist râles and squeaks in the lungs.

April 18 the following information was obtained from Dr. Marks, the junior house officer, and from the nurse in charge of the patient: The patient felt poorly the morning previous. He vomited his salts; his pulse was weak and irregular; he became progressively weaker. His respiration, affected from the start, became more and more labored, and finally resembled Cheyne-Stokes respiration without the periods of apnea. The patient was very cyanotic. His condition seemed so serious that he was placed on the dangerous list.

My attention was called to this case by Dr. Duke, one of the house physicians, who brought me a specimen of urine with a specific gravity of 1.070, and it was in answer to my inquiry regarding the case that I received the above history. I immediately advised the discontinuance of magnesium sulphate for this patient because I was led, from my experience with Case 1, to suspect magnesium sulphate as being the cause of the high specific gravity of the urine. Fortunately the patient had received no salts that morning on account of his weak condition.

April 24 the heart action was less irregular; lungs still showed many coarse râles; temperature still slightly elevated; patient up without ill effects.

The chemical analysis of the 120 c.c. specimen of urine obtained, yielded 0.4813 gm. of magnesium calculated as oxid, and corresponding to 1.42 gm. magnesium sulphate.

In my opinion this case is one of cumulative poisoning produced by a partial absorption of the doses given on

5. Schmiedeberg: *Grundriss der Pharmakologie*, 1906, p. 416.

6. Clessin: *Ueber die giftige Wirkung der Magnesium Salze*, Würzburg, 1881.

7. Recke: *Experimentelle Beiträge zur Kenntniss der Wirkung der Magnesia sulphurica*, Diss. Göttingen, 1881.

8. Meltzer and Auer: *Physiological and Pharmacological Studies of Magnesium Salts*, *Am. Jour. Physiol.*, 1905-1906, xiv, 366.

9. Boston Lying-In Hosp. Rec., 1909, cxlvii, 198.

10. Mass. Gen. Hosp. Rec., 1909, decxvii, 71.

April 14, 15 and 16. The salt given on April 17 served to hasten the onset of the attack.

CASE 3.—E. I. B., aged 26, milliner, diagnosis, tapeworm.

May 23, on entrance to the hospital patient's urine showed a specific gravity of 1,008, albumin, slightest possible trace, no sugar. Patient was put on liquids without milk, and was given 5 grains of calomel that evening.

May 24, the patient was given 7 ounces of Epsom salt, 1 ounce every hour and a half during the morning, with excellent result. No vomiting.

May 25, patient vomited two doses of the salt. There was nausea the rest of the day. Urine, specific gravity 1,029, albumin slightest possible trace. Stool, normal in color, formed, eggs and segments of tenia present.

May 26, patient vomited two doses of salt. She was allowed to rest as quietly as possible, with the hope of beginning treatment.

May 27, patient vomited her medicines; she refused all food and drugs, except teaspoonful doses of albumin water and was beginning to look worn and haggard. She was fed by rectum and given enemas of salt solution. These enemas she retained well.

May 28, all idea of treatment for worm was given up; patient vomited even water. Physical examination was negative except for acne, which appeared two days previously.

May, 30, condition of pernicious vomiting continued. Patient was able to retain only teaspoonful doses of milk and lime water or albumin water, and she often vomited these. The vomitus was green and slimy. The patient looked pale and drawn. The pulse was good, the temperature normal. The patient was sleepy most of the time; she lay with eyes closed and hardly seemed to notice what was going on. The nausea was unrelieved. Patient said she could not move her limbs; she thought she was paralyzed. The patient's face was puffy. She was restless and querulous during the night.

The urine was pale, slightly cloudy, specific gravity 1,013, slightest possible trace of albumin casts present. The urine seemed much diminished; patient thought she had not passed any urine for several days, but the nurses thought that she had passed some urine with her stools and when she discharged nutrient enemas.

May 31, at 5 a. m. the pulse suddenly became weak; a few minutes later the house physician found patient pulseless and of a dirty ashen color. The patient was conscious when the heart was merely fluttering. Death occurred at 6 a. m.

Autopsy (M. G. H., Pathological Records, 1906, p. 273; autopsy 1,694).—Pleural cavity contains a slight amount of pale fluid. Peritoneal cavity contains a moderate amount of pale fluid and several pale yellow fibrin clots. Stomach and small intestinal mucosa shows patches of reddening. Kidneys weigh together 320 gm. The epithelium of the cortical tubules is generally flattened, the lumen of the tubules is rather larger than normal. The interstitial tissue is edematous in places. The epithelium of the glomerular capsule is thicker than usual, but there is no evidence of a glomerulo-nephritis, and there is no increase in interstitial tissue. The appearance of the kidney suggests the action of some toxic substance.

This case is undoubtedly one of magnesium poisoning. Unfortunately the urine was not examined for the presence of the salt, but the specific gravity of the urine of May 25 tells the story. At entrance the urine showed a specific gravity of 1,008; on May 25 the specific gravity was 1,029, although the patient had been taking practically no food. On May 31, when nearly all of the salt had been excreted, the specific gravity was 1,013. I have no doubt that specimens with a much higher specific gravity were passed in the twenty-four hours following the voiding of the specimen which was obtained on May 25. This specimen was passed at a time when the excre-

tion of the salt was just beginning. This is another case of cumulative poisoning.

CASE 4.—Under the title, "Epsom Salt as a Poison," C. Fraser¹² reports a most interesting case of magnesium poisoning. A boy, aged 3½ years, took 1½ ounces of magnesium sulphate, mistaking the salt for sugar. On account of the bitter taste he drank a little milk to wash it down. The child's mother found him soon after this, retching and suffering much pain. He complained of great thirst; his bowels had not moved. The nausea and retching continued all day. At 7 p. m. the pain was very severe and vomiting began. The patient suffered great pain all through the night and vomited at frequent intervals. When Dr. Fraser first saw the child at 2:30 p. m. it was twenty-five hours after he had taken the salts. He found the boy in bed with his face pinched, his eyes sunken and the skin very pale. His mind was clear. Every 2 minutes he had a colicky attack which made him draw up his legs. Temperature 100 F., pulse small, 160. Respiration labored. His tongue was very dry, the papillae standing out prominently. His thirst was intense. There had been no movement of the bowels in twenty-four hours. The patient had passed only a half ounce of urine in twenty-four hours. Physical examination showed the abdomen to be distended and rigid, and the skin hyperesthetic. Catheterization yielded ½ ounce of bloody urine, no albumin and no sugar, very acid. The patient was weak and was constantly growing weaker. He vomited every few minutes small amounts of greenish-yellow material without any characteristic odor. The bowels were constipated, temperature and pulse the same.

Next day, vomiting was incessant as before, no movement, no urine, pulse uncountable. The abdomen was so distended and tender that it was feared the boy had peritonitis. He was therefore admitted to the hospital for laparotomy. The child was now in complete collapse, his temperature was subnormal, his pulse 160, the abdomen rigid and retracted. Laparotomy was done and two pints of sterile blood-stained serum obtained from the peritoneal cavity. No cause for intestinal obstruction to be found.

The first twenty-four hours in the hospital the temperature was 100.6 F., pulse 170; child was very ill and restless; he vomited frequently; no flatus or feces were passed in spite of frequent enemas. The child complained of intense thirst. Considerable quantities of blood-stained serum continued to drain from the peritoneal cavity. The dressing was changed every four hours. The child became moribund, and albumin water, brandy and rectal salines were not retained.

The second twenty-four hours the child still seemed moribund; pulse uncountable. Normal saline solution was infused into the subcutaneous tissue of the axilla, after which the child improved, obtaining some sleep. There was still some vomiting, which, however, soon stopped. Half grain of calomel was given every hour. Temperature 101.5 F. In the afternoon flatus and feces passed and again after an enema. Catheterization at 4 p. m. yielded 1 ounce of urine. Recovery now followed quickly.

In this case the action of the salt after absorption into the blood had caused paralysis of the intestine. The slow excretion of the salt was also responsible for the almost complete suppression of the urine, the salt, by its great affinity for water, preventing the excretion of water by the kidneys.

CASE 5.—Neale¹³ reports the case of a boy, aged 15, who took 1 ounce of magnesium sulphate in concentrated solution on an empty stomach. The physician arrived after twenty-four hours. In the meantime the boy had had three small movements. A few hours after the dose he felt sick and vomited; this condition continued through the night. The next day he tried to work, but had to give up. The vomiting continued at intervals. When the physician came the patient was lying in an attitude of flexion; he was much cyanosed; from time to time he had severe attacks of tetanic spasms,

11. Mass. Gen. Hosp. Rec., 1906, dextl, 122.

12. Fraser, C.: *Lancet*, London, April 24, 1909, p. 1174.

13. Neale: *Pharm. Jour.*, 1896, p. 235.

affecting the right side of the face and the right arm. The urine was dribbling. The pulse was imperceptible. He frequently vomited greenish fluid material. His temperature was 105 F. The next day he was better; 40 ounces of urine were withdrawn by catheter. He was well in a week.

In this case there was evidently a paralysis of the sphincter of the bladder. The tetanic convulsions are an interesting symptom. Two of the ten cases showed convulsions.

CASE 6.¹⁴—A woman in Dundee, Scotland, took 4 ounces of Epsom salt in concentrated solution at one draught. Half an hour later she felt so ill that she sent for a physician. An hour later she died. There was no purging. These are all the facts obtainable in this case, except that death was certified to as due to paralysis from an overdose of salts. There was no inquest.

The cause of death as given in the physician's certificate suggests that there was motor paralysis in this case.

CASE 7.¹⁵—Luff¹⁵ reports the following case: A woman servant aged 20 was found on her bed in the morning. The bed had not been slept in. Death had occurred some hours before. The autopsy was negative except for the presence of a light-colored semifluid mixture of water and magnesium sulphate in the stomach. Death was stated to have been caused by syncope. There was no purging. The salts had been taken on an empty stomach. It was learned later that the young woman had purchased 1 ounce of Epsom salt the day before from a neighboring apothecary.

CASE 8.¹⁶—Sang¹⁶ reports the case of a woman of 35, who took 4 ounces of Epsom salt in warm water to bring on the monthly period. Immediately after taking the salts she felt a burning pain in the stomach and bowels. Her breathing became difficult, she had a choking feeling, also a sensation as if the power were leaving her legs. There was no vomiting and no purging. Her pulse was 98 F.; the pupils were dilated; at times there was slight twitching of the face, but complete paralysis rapidly ensued, the patient became comatose and died seventy-five minutes after taking the salt. The radial pulse was felt for two to three minutes after respiration had ceased. There was no autopsy.

This case is one of the most typical of the ten. It shows the paralysis of respiration in a truly classical manner; also the final complete motor paralysis. Like the third of my cases, the victim in this case spoke of a sensation as if the power were leaving her legs. If Patient 3 had lived longer motor paralysis would probably have developed in her case also. In connection with this case it is interesting to note that Lewin,¹⁷ reporting Case 8 in his text-book on toxicology, expresses his doubt of its being a case of magnesium poisoning because the victim was not purged.

CASE 9.¹⁸—A boy aged 10 was given 2 ounces of Epsom salt for worms. The salt was partly dissolved and partly mixed in a cupful of water. Immediately after swallowing the mixture he staggered and fell. Half an hour later the physician found him breathing slowly and with difficulty. The pulse was imperceptible and the boy was in a condition of collapse. He died in forty minutes. There was no vomiting or purging. The autopsy was negative.

This case is remarkable for the suddenness of the onset, which is strongly suggestive of rapid absorption from the stomach.

CASE 10.¹⁹—An old man who was rather a heavy drinker was the victim of a practical joke. A number of his companions put a large quantity of Epsom salt into his beer. After he

had drunk several pints he was suddenly seized with violent purging. He died forty-eight hours later. The autopsy showed the mucous membrane of the gastro-intestinal tract to be inflamed.

The victim in this case may have died in consequence of the violent purging alone.

CONCLUSIONS

In one of these cases only, that reported by Taylor, active purging took place. The victim in this case was given Epsom salt in several pints of beer; the beer served to produce a dilute solution which escaped absorption, and therefore caused powerful catharsis. In Case 3 there is said to have been a good result after the seven doses of Epsom salt, but probably the patient drank with some of her doses of salt an amount of water sufficient to so dilute the salt that it was not absorbed. The patient in Case 4 is reported to have had three small movements. In all the other cases there was no catharsis; the salt, which was taken in concentrated solution, caused paralysis of the bowel after its absorption into the blood. This paralysis was so marked in Cases 1 and 4 that laparotomies were performed.

In all cases there was also a diminution of the urine, which in some cases amounted almost to anuria. The effect on the urinary secretion is due to the presence of the salt in the blood and tissues. On account of its great affinity for water the salt converts a large part of the body fluids into an Epsom salt solution, which, being itself excreted only very slowly, holds the water back and reduces or prevents the secretion of urine.

Among the symptoms observed the paralyzing effect of the salt on the respiration was very prominent; it was spoken of in six cases. Convulsions, described as tonic in character in Neale's case, were seen in Cases 5 and 8. Dilatation of the pupils was observed in Cases 4 and 8. Motor paralysis was seen in Cases 6 and 8, and paralysis of the reflexes seems to have been present in Cases 3 and 8. Vomiting occurred in about one-half the cases.

The most characteristic findings disclosed by operation or autopsy are patches of reddening on the mucosæ of the stomach and intestines and free fluid in the abdominal and pleural cavities (Cases 3, 4, 10).

Fraser's case (4) suggests one very efficient remedial measure, namely, infusion with normal saline solution. The saline infusion given the child undoubtedly saved his life. I think, however, that intravenous application is preferable to intramuscular or subcutaneous infusion, because the relief of the patient will be more prompt and the chances of saving life will be better. The fluid introduced probably acts by diluting the Epsom salt so as to render it less toxic; the more dilute solution is also excreted more rapidly by the kidneys. Meltzer's²⁰ experiments on animals suggests a specific antagonistic action to magnesium on the part of calcium salts. The intravenous or subcutaneous application of lime salts may therefore be of great value in the treatment of magnesium poisoning.

On account of its paralyzing action on the reflex centers of the cord Meltzer²¹ has advised the subcutaneous use of magnesium sulphate in cases of tetanus. Such application should be made with the greatest care only. I can conceive of the remedy being quite as bad as the disease.

14. Brit. Med. Jour., 1891, II, p. 490.

15. Luff: Brit. Med. Jour., 1891, II, 490.

16. Sang: Lancet, London, Nov., 7, 1891, p. 1037.

17. Lewin, Lehrbuch der Toxicologie, 1897, p. 99.

18. Christison: On Poisons, p. 574.

19. Taylor: Poisons, p. 4.

20. Meltzer, and Auer: Am. Med., 1905, x, 918.

21. Meltzer: Inhibitory and Anesthetic Properties of Magnesium Salts, Med. Rec., New York, 1905, LXVIII, 905.

SUMMARY

1. Magnesium sulphate in bulk or in concentrated solution is absorbed, in part at least, from the gastrointestinal tract into the blood.

2. If a sufficient amount of the salt is absorbed at a given time poisoning will result; of the ten cases reported six resulted fatally. The symptoms and autopsy findings in these cases agree very well with those obtained in animals after the intravenous application of magnesium sulphate.

3. On account of the slowness of its excretion from the system, magnesium sulphate, given repeatedly in concentrated solution, may produce poisoning by cumulation.

4. In normal conditions of the bowel magnesium sulphate, in proper dilution, is a valuable cathartic; Hunyadi water, for example, is practically a 3 per cent. solution of Epsom salt (magnesium sulphate 1.5 per cent., sodium sulphate 1.5 per cent.)

5. It is not wise to give magnesium sulphate indiscriminately in cases of so-called acute intestinal obstruction, because when peristalsis is much diminished or absent, and in cases of mechanical obstruction of the bowel, even dilute solutions will be absorbed, with consequent danger of poisoning.

6. In cases of suspected magnesium poisoning large quantities of normal salt solution should be given intravenously. Dilute solutions of lime salts given hypodermically may also be of benefit.

7. The subcutaneous use of magnesium salts to produce catharsis, as proposed by Wade,²² is not only absolutely irrational, but dangerous.

374 Marlboro Street.

ABSTRACT OF DISCUSSION

DR. PHILIP S. ROY, Washington, D. C.: Wolfgang Pauli of Vienna, about 1905, in discussing sulphate of magnesia and some of the other powerful purgatives called attention to their danger. Pauli says that the purgative action of sulphate of magnesia is due to its irritating and caustic action on the tissues, also to a rise in blood pressure. The ion relations of the sulphate of magnesia to protein are similar although not so powerful as those of the bichlorid of mercury. Pauli's article impressed on me forcibly the idea that care should be used in giving the sulphate of magnesia.

DR. NATHAN ROSEWATER, Cleveland, Ohio: Magnesium citrate is the form of magnesium salt which I give when I wish to produce catharsis. I prescribe it in concentration equivalent to one and one-third ounces of the salt in from four to six ounces of water. In my experience of many years, I have never seen such effects as described by Dr. Boos. It seems to me that one of the cases he reported should be ruled out because the effect was so immediate; absorption can hardly take place so fast as is indicated in his description of the case. In the other cases too I think that the results must have been due to something else than the magnesium, perhaps to the condition for which the drug was given. In only one or two cases do I believe that the Epsom salts seem to have had anything to do with the poisonous results. I have had a large experience with the use of the salts of magnesium and I have never encountered any untoward effects whatever, and have preferred a concentrated solution. It would require more than the report of two cases to make me believe that this agent is a poison, instead of having merely been used in cases with a toxic or fatal ending.

DR. H. E. DUNLAP, Canton, Mo.: It has been my experience, as I am sure it has been of the majority of physicians present, that magnesium sulphate is not at all toxic, at least in the dose usually administered. Does not Dr. Boos believe

that idiosyncrasy had much to do with the results reported in his paper?

DR. D. C. WALT, Little Rock, Ark.: Magnesium sulphate is a valuable agent because of its affinity for carbon which exists in all ptomain bodies. It seems to have the power of neutralizing the toxic value by drawing to its embrace the carbon which is the basic element in poisonous compounds, whether it is the CHNO or CHO group. Nature handles the animal economy on a general plan and that plan is modified or influenced by certain conditions. I dislike to hear anything said against magnesium sulphate because it is one of the most commonly used and cheapest drugs and also one of the most valuable in medicine to-day. With regard to the toxic condition, we must remember that in the snake and in the wasp the toxic effects are based on natural laws, and the toxic effects are regulated by a relation to carbon. I have had a personal experience with this agent as well as in my practice. I have a chronic affection which has been diagnosed as epithelioma, and I have used magnesium sulphate every day for over five years.

DR. LOUIS LEROY, Memphis, Tenn.: The report of these cases is extremely interesting and I think they are sufficiently numerous to warrant consideration. What has been stated does not strike me as being a plea to discredit the giving of magnesium sulphate by any means; we must remember, though, that there are certain cases which result unfavorably after the administration of this agent. There seems to be no question but that a solution of magnesium sulphate cannot produce any toxic effects unless the metal in some way unites itself with some other substance. Idiosyncrasy is not usually a question of concentration, but of substance. It seems that it is only when in great concentration that magnesium sulphate is injurious, so that this would seem to argue against idiosyncrasy as being responsible for the unsatisfactory results. On the other hand, I believe that there is very little general toxic action resulting from the administration of magnesium sulphate. The question then arises: Is there not some other toxic material linked with the magnesium and which is absorbed at the same time through the intestines? That would be my interpretation of the cases reported by Dr. Boos. I should say that his cases were the unusual ones; possibly there was an incompletely digested material, or possibly the production of some ptomain substance, which was absorbed and thus caused the poisonous effect. These possibilities must be borne in mind and the report of but one or two instances of supposed poisoning from the administration of sulphate of magnesium should not be accepted as a statement that this is the sole poisonous agent.

DR. JOHN D. REID, Pilger, Neb.: I should like to report a case which came to my attention last month, but which was not in my practice. The wife of a blacksmith had not been feeling well for several hours. Thinking that it would do her good, the husband gave her a dose of Epsom salts. Within one hour the woman was dead, whether from magnesium poisoning or not I do not know. Her husband was arrested for murder and the preliminary trial is to be held soon.

DR. W. H. PHILP, St. Francis, Ark.: These reports of deaths from the administration of common, everyday salts are interesting, and recall to my mind the case of a woman who was operated on for a minor gynecologic condition. Two or three days afterward she was given a small dose of salts, not more than 4 drams, and she was dead in one and a half hours, after having just such a set of symptoms as Dr. Boos has described. The case was then recognized as one of magnesium poisoning, but this is the first time it has ever been reported.

DR. GEORGE R. NEFF, Farmington, Iowa: I have been using magnesium salts for years, and have never been so successful with them as I have during the last five or six years. I use magnesium internally and externally and expect to use it eternally. I think the sulphate of magnesium is one of the best agents we can use externally for the relief of pain, especially when used with phenol in the proportion of water 16 ounces, salts 1 ounce, phenol 10 drops. In the pleuritic pains in pneumonia, for instance, if this mixture is applied over the chest there are good results. In a knee joint affected with rheumatism, its action is like magic. Think of giving 7 ounces

22. Wade: Med. and Surg. Reporter, 1894, No. 4.

of sulphate of magnesia at one dose! Why should we not get toxic effects from such dosage? It should be remembered that we get toxic effects from medicines, just in proportion as carbon is contained in them. The more carbon the more toxic they are. Epsom salts are eliminative, given in proper doses. Take a case of bronchitis with a continuous hacking cough, and distress; using the following prescription: Epsom salts 3 drams, saccharin 3 grains, tincture of peppermint 10 drops, water 3 ounces, one teaspoonful every hour, the finest results are obtained. It will loosen the dry hacking cough and make a free discharge of mucus and all the symptoms will be relieved. If I had to make a choice of one medicine alone in the whole materia medica to-day, I would choose Epsom salts.

DR. WILLIAM F. BOOS, Boston: I wish it to be distinctly understood that I would not have physicians discontinue the use of magnesium sulphate; I think it is one of the best drugs for the hospital, because it is cheap and efficient in action. But the salt should be given in proper form. Whenever magnesium sulphate is given in greater concentration than 6 or 7 per cent. it is absorbed in part and may produce intoxication. In one case in which the 24-hour urine was examined after the patient had received 1 ounce of magnesium sulphate dissolved in 3 ounces of water (a 33.3 per cent. solution), the urine was found to contain 104 per cent. more magnesium, calculated as oxid, than was normally present. In another instance in which Epsom salt was given in 13.3 per cent. solution, that is, 1 ounce magnesium sulphate in 6 ounces of water, the urine contained 60 per cent. more magnesium than normally. When, however, magnesium sulphate is given in 5 or 6 per cent. solution, that is, $\frac{1}{2}$ ounce magnesium sulphate to 9 ounces of water, there is catharsis and none of the salt appears in the urine.

The last case I reported is probably not one of uremia, because the convulsions in uremia are clonic and not tonic in character. In one case the specific gravity of the 3-ounce specimen was 1,070, it was free from sugar and it contained the equivalent of 1.4 grams of magnesium sulphate. There is no doubt that this was a case of magnesium poisoning and that the high specific gravity was due to the Epsom salt. It is only when we find an excess of magnesium in the urine that we can be certain that the salt was absorbed into the blood and that it was the cause of the intoxication. When the specific gravity of the urine is 1,070 or 1,080, as in the cases reported, or when it is above 1,030 in sugar-free urines generally, this form of intoxication should be thought of. It was only by accident that I found there was such a thing as magnesium poisoning. Magnesium sulphate was injected into the spinal canal by a man in Boston; the patient recovered consciousness about twenty-four hours later. I think it has not been given since. To produce intoxication this agent must circulate in sufficient quantity in the blood. In the cases enumerated, it was absorbed into the blood from the gastrointestinal tract, and the effect is the same as when it is injected intravenously; in both cases we get symptoms typical of magnesium poisoning. Magnesium sulphate should be given well diluted; 1 to 18 is the proper dilution; that is, $\frac{1}{2}$ ounce of the salt dissolved in 3 ounces of water, followed immediately by a glass of water. Such administration will produce prompt catharsis without absorption. In certain hydremic conditions with edema or with fluid in the peritoneal or pleural cavities, even a concentrated solution is not absorbed. I have the records of one autopsy at the Massachusetts General Hospital. The peritoneal and pleural cavities of this patient contained a small amount of fluid and some fibrin clots, the epithelium in the tubules of the kidney was flattened and the interstitial tissue was edematous; there was no evidence of a glomerulo-nephritis, however. The condition of the kidneys suggested action by some toxic material. We do not know how quickly the salt may be absorbed from the stomach, very little being necessary to cause severe symptoms. Idiosyncrasy must always be considered as a possible factor. I do not believe it wise to give magnesium sulphate in cases of intestinal obstruction; in such cases there is a greater tendency to absorption and the longer the salt remains in the bowel the more will be absorbed.

THE DIFFERENT FORMS OF MEDIASTINAL PLEURISY WITH REPORT OF THREE CASES *

ANDERS FRICK, M.D.

Attending Physician Augustana Hospital
CHICAGO

DEFINITION

By mediastinal pleurisy, anatomically speaking, we understand, of course, an inflammation of the part of the parietal pleura which covers the mediastinum, the anterior as well as the posterior. But when we speak of mediastinal pleurisy as a clinical entity we differentiate it as a particular form of pleurisy, not merely because the mediastinal pleura happens to be inflamed, but because in certain clinical aspects it differs radically from ordinary pleurisy. This difference is, however, present only in those cases in which the inflammation of the mediastinal pleura leads to the formation of an encysted gathering of exudate between the mediastinum and the internal surface of the lung. In the following description I shall therefore confine myself to cases of this kind, with exclusion, for instance, of cases in which the inflammation of the mediastinal pleura is a pleuritis sicca, or, if exudative, occurs in conjunction with inflammatory changes in the rest of the pleura with free communication between the different parts of the pleural cavity.

It is owing to the proximity of the mediastinum and its organs that mediastinal pleurisy differs in symptomatology, in diagnosis, and in prognosis from ordinary pleurisy. The characteristic symptoms of mediastinal pleurisy vary, however, according to what part of the mediastinal pleura is involved. A gathering of fluid in front of the right pulmonary peduncle does not give the same symptoms as one in front of the left, and both these forms of mediastinal pleurisy differ in their clinical manifestations from those produced by a gathering of fluid behind the pulmonary peduncle, which, on the other hand, is liable to give the same symptoms, no matter whether it is located on the left or the right side of the posterior mediastinum. We may therefore distinguish between three forms of mediastinal pleurisy: (1) pleuritis mediastinalis anterior sinistra, (2) pleuritis mediastinalis anterior dextra and (3) pleuritis mediastinalis posterior.

It will be my endeavor in this paper to show the justification and the importance of such a distinction.

PLEURITIS MEDIASTINALIS ANTERIOR SINISTRA

Out of the eleven cases reported of left anterior mediastinal pleurisy, seven are described with sufficient detail to give us a comprehensive picture of this form of pleurisy.

ANDRAL'S CASE 1.⁸⁶—A man of 29, infected with tuberculosis, suddenly had an acute pain between the left breast and sternum with intense anxiety; the countenance was pale, the breathing short and hurried, the pulse hard and frequent. Six days later, a dulness was found between the left breast and the sternum, where respiratory murmur was absent and heart-sounds were weak. The dulness spread over almost the

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* Owing to lack of space, this article is abbreviated in THE JOURNAL by omission of the historical review and the references to literature. The article appears in full, however, in the Transactions of the Section and in the author's reprints.