UTILITY OF SALINE SOLUTION IN TREATMENT OF FEVER.*

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Increasing experience in the employment of physiologic saline solution (6/1000) by the mouth in all febrile states in children encourages me to offer present certain conclusions. This solution was formerly and erroneously called "normal salt solution." My findings are not sufficiently comprehensive as yet to report in full, but this shall be done later.

In a paper¹ read as part of a symposium on pneumonia before the Medical Association of Greater New York, Dec. 11, 1905, the rationale and value of the measure was outlined, with some items of history and personal experience.

The use of salines by hypodermoclysis and later by enteroclysis has become an established form of treatment affording relief in many exceptionally severe disease states. The results noted in patients *in extremis* have been pretty well established to be of more than partial value. The effects attributed to this agency are variously interpreted. In this short communication it must suffice to outline the physiologic warranties and to point out such explanations of the indications as are so far acceptably offered.

NEED OF SALINE SOLUTION.

Biologically it is admitted that, our origin being from marine forms of life, our cells still retain certain features exhibiting marine characteristics. The fluid media, the body fluids, the blood, depend for their most important activities chiefly on an adequate proportion of chlorid of sodium, whatever rôle the other salts may play. The significance of this fact was clearly set forth by Sajous,² who made plain that the chief rôle, in the maintenance of the integrity of the blood, is played by the status of its alkalinity. Some distinctly original observations and conclusions are presented bearing practically on our interpretation of vital phenomena, fully sustained by citations.

A brief outline of the clinical bearings of these facts may serve as clinical indications. The plasmatic salines are supplied variously in the food in health, as condiments and as constituents of certain articles, but in disease a restriction and alteration of customary diet, anorexia, etc., cuts this down. The outgo proceeds unchecked, in many conditions it is markedly increased. There being no intrinsic reserve, since the source of supply is wholly external to the organism, the tissues must soon suffer a saline starvation, with its obvious consequences: impairment of cellular interchanges, osmosis, diapedesis, etc., but especially a lowering of the oxygen-carrying power of the plasma. In my paper¹ referred to it is said, whatever theory of immunity we adopt, whether we conclude with Büchner that the blood protects the body through the presence in this tissue of "alexins," whether, with Ehrlich, we grant the tissue cells the power to secrete "receptors," whether we agree with Sajous² that the internal secretions supply the needful protective agents to the blood, the fact remains that the life fluid is unquestionably endowed with a substance capable of staying the hand of death when

conditions are such as to enable it to act unhindered. "We know now," recently wrote Behring, "that immunizing antibodies regularly appear in the blood whenever an infectious disease terminates in recovery." Is this not the one feature of the problem which should command our keenest interest? Have we not here the one greatest weapon through which it is possible to reach and overcome deadly pathogenic elements? It is to this weapon and to the preservation of its integrity as a potent means of attack that reference is here made. We are looking on all sides for immunizing sera, which, like antitoxin in diphtheria, will enable us to cope with the great scourges of humanity, among which pneumonia is rapidly taking the lead. In a recent address, Behring, advancing it as a biologic law, says: "Specific immunizing substances can be obtained in no other way than from the blood and organic juices of individuals who have passed through the diseases against which we wish to produce immunity." Now, since saline solution can, as proven experimentally, maintain the blood's antitoxic properties, it can do so only by enabling these blood and tissue juices to act efficaciously and specifically, and, according to Sajous, the early use of saline solution, in all febrile infections, must, therefore, produce the effects that we are trying to obtain from specific sera.

We fail to preserve economically the integrity of the immunizing principles of the blood if we wait until the system is practically overwhelmed by toxins; until the functions of the cells that produce them are well nigh paralyzed; until the lungs are engorged to such an extent that cyanosis occurs; until pulmonary edema is present or threatened; until the overworked kidneys can withstand no further sudden assaults of toxic waste; until the blood, already poor in oxygen, can hardly bear dilution, and, finally, until the nerve centers are so dulled that they no longer respond to peripheral impressions. As well to wait for the moribund stage to occur in a case of diphtheria before using antitoxin as to employ saline solution during this stage of desperate struggle.

Very different is Sajous' conception of the importance of the early and constant use of saline solution. Here all untoward features, just reviewed, are taken into account, and the aim is eminently in keeping with the most advanced teaching of experimental research, namely, "to preserve and enhance the blood's bactericidal and antitoxic properties from the outset of the disease." This was embodied over three years ago by Sajous in a sentence which should be carefully noted, since it has already been instrumental in saving life:

The primary effect of deficiency of alkaline salts in the blood being to inhibit nutrition, to impair the efficiency of, and finally arrest the protective functions of the organism, it constitutes one of the most active causes of death.

The practical importance of the blood's alkaline salts has been emphasized repeatedly. A brief quotation from Howell's recently published "Physiology" will suffice:

The salts of the blood have most important functions. They maintain a normal composition and osmotic pressure in the liquids and tissues of the body, and by virtue of their osmotic pressure they play an important part in controlling the flow of water to and from the tissues. Moreover, these salts constitute an essential part of the composition of living matter. In some way they are bound up in the structure of the living molecule, and are necessary to its normal reactions or irritability.

BLOOD SALTS AND FEVER.

Now, given any disease attended by marked fever, the loss of the blood's main salt, sodium chlorid, is not replaced, owing to restricted diet, anorexia, and the many

* Read in the Section on Diseases of Children of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. N. Y. Med. Record, Jan. 13, 1906.

2. "Internal Secretions and Principles of Medicine," 1903. p. 778 et al.

factors which cause the patient to reduce greatly the intake of normal food. At least one-half ounce of sodium chlorid being voided daily in the urine of an adult, the time soon comes when the cells are hampered in their vital functions, they gradually cease to secrete their auto-protective antibodies, thus giving free sway to the pathogenic elements. In pneumonia especially, the cells hold their sodium chlorid in reserve and the salt soon ceases to appear in the urine. But watch these cases; notwithstanding Nature's attempt to thwart a desperate situation, the patient steadily sinks, deprived of that which represents in this connection their *pabulum vitæ*. Sajous' teachings are thus summarized:

Steadily as the febrile process advances the salts are consumed, and being inadequately renewed, the vital and defensive functions are increasingly hampered until life ceases.

Hence he advises early and continuous use of saline solution, from the outset, at the end of all fevers, so as to avoid any chance of reaching an individual danger limit.

What connection is there between a febrile process and the adequacy of the blood salts? In reply I quote from a book³ published since the above teachings were placed on record. Referring to the diminution of the blood alkalinity during fever, the author says:

The cause of this change is unknown, but whatever the true explanation may be, it is probable that the change is highly important for the organism, for it is an unfavorable sign in febrile disease, and it is known that diminished alkalinity of the blood goes hand in hand with increased susceptibility to infection.

Sajous has already adduced considerable experimental evidence to the same effect, including that contributed by Metchnikoff, Behring, Nissen, Paul, von Fodor, Blumenthal, and many other authorities.

My friend, David Riesman, says that he is inclined to attribute my effects chiefly to the ingested water. His rule, in adult cases of fever, is to insist that they take four ounces of water every two hours. This induces polyuria, up to 80 or 90 ounces daily. He is convinced that nervous symptoms are thereby made less pronounced; there is less tympany and the tongue is more moist. The bowels are not made loose. My findings are on similar lines, but the bowels seem to do better for the salt. Valuable as the use of excessive amounts of water undoubtedly often is, we should approach the subject with caution, having due regard to the possible dangers of injudicious urging to take as much as possible. In this connection it is pertinent to refer to the suggestive paper of Morris Manges,⁴ who also quotes Kraus.⁵ In his (Kraus') recently published treatise on the "Dietetic Treatment of Cardiac Disease" he says:

Water once within the body is no longer (merely) water, but must be considered in its relations to the various salts, colloids, etc., with which it comes in contact. . . . Every drop of water introduced into the system must be excreted directly or indirectly, by the heart . . . increasing the demands on that organ.

He agrees with von Noorden that the increased drinking of water does not materially affect the breaking down of albumins. The increase of metabolism, on the whole, is great, but takes place at the expense of the carbohydrates and fats. An important point quoted from Baruch is that, whereas ingestion of hot water raises

pulse rate and lowers blood pressure, cold water diminishes pulse rate and raises blood pressure, but water of 60 F. has very little effect. In a case in which the heart is no longer competent or weakened, we do well to heed the fact, pointed out by von Noorden and his pupils (Ritter, Dapper, Reetkowski and Mohr), that the daily quantity of water should be restricted to one and one-quarter liters (about 2½ pints) daily, exclusive of fluids in food. The elimination of important salts, he says, is not lessened by this restriction. Manges recommends that in infectious diseases and septic conditions the water should be given cold and in frequent small quantities.

AUTHOR'S METHOD.

My own method is to give to all children, in whom a rise of temperature occurs, freely of the normal physiologic saline solution (6/1000) usually half an hour before feeding time, every three hours. They are encouraged to drink all they will. For infants the saline solution (6/1000) is used in the modification of milk and in diluting whatever food is used. Children rarely object to the saline taste, which, indeed, is scarcely perceptible, and soon become accustomed to it. My head nurse, service of 1905, Miss Hill, tells me children occasionally noticed its unusual taste, but soon grew to like it. During my present service, Miss Fox, head nurse, tells me she observes no objections at all. Both volunteered the remark that the cases progressed apparently more satisfactorily under the saline régime.

As to the elimination of skin and kidneys, always difficult to estimate in young children, we have not secured exact data. In another year, with coöperation of my colleagues, it is hoped to make a more complete study of these points. It is likewise obviously difficult to institute accurate comparisons with cases treated otherwise. It is my hope to interest physicians whose opportunities for clinical experience are large, to employ this exceedingly simple, convenient and eminently rational auxiliary treatment. It furnishes, in reality, a form of food and, to my mind, is the essential principle of febrile dietetics.

CASE SUMMARIES.

Appended are the notes of eleven cases from my present service, chosen solely on account of their extreme severity, all showing grave complications. Four of these patients died soon after admission, being classified as moribund; yet two of these survived longer than was deemed possible.

CASE 1.—A. E., aged 10 months, was admitted April 3, 1906, ninth day of double pneumonia, accompanied by pronounced meningeal symptoms. Temperature for four days, 102 to 104.5, pulse 130 to 180, respirations 40 to 60. On fourth day temperature dropped by lysis, with corresponding drop of pulse and respiration, meningeal symptoms cleared up gradually and patient was discharged cured two weeks after admission.

CASE 2.—H. M., aged 9, was admitted April 27, 1906, second week of typhoid fever, along with bronchopneumonia at right apex. Temperature 102 to 104 for seven days; pulse and respiration correspondingly high. Dropped by lysis eighth day after admission. No other complications. Discharged cured May 25, 1906.

CASE 4.—W. H., aged 1, was admitted May 1, 1906; double pneumonia. Patient was cyanotic, temperature 99 to 101, pulse 160 to 170, respirations 90 to 100. Died 16 hours after admission.

CASE 5.—J. W., aged 22 months; had pneumonia six weeks previously in hospital. Patient returned May 7, 1906, with double bronchopneumonia. Temperature 100 to 105, pulse 140 to 180, respirations 50 to 90. Distressing dyspnea. Died May 12, 1906.

3. Lazarus Barlow: "General Pathology," 1905, second edition.

4. "Dangers of Excessive Water Drinking," N. Y., Med. Jour., Jan. 21, 1905.

5. Handbuch der Ernährungs Therapie, von Leyden und Klempner, 1903.

CASE 6.—D. F., aged 8, was admitted April 1, 1906, on probably the third day of a typhoid, along with pneumonia at right apex. Temperature 103 to 105, pulse 120 to 150, respirations 36 to 56 until the ninth day, when temperature dropped by lysis. During the first week there was marked distension of abdomen, lasting about three days. Patient was discharged cured April 30, 1906.

CASE 7.—J. DeG., aged 6, was admitted April 1, 1906, fourteenth day of typhoid, with meningeal symptoms. Temperature first seven days 101 to 104, pulse 120 to 160, respiration not accelerated. At the end of second week (nine days of disease) the temperature was normal. Two days later patient showed symptoms of pneumonia. Temperature for next seven days 101 to 104.5, pulse 140 to 160, respirations 40 to 54, dropped by lysis. Patient, who had been sullen and rather stupid from time of admission, brightened up rapidly on seventh day and was discharged in good condition May 28, 1906.

CASE 8.—D. R., aged 10 months, was admitted April 1, 1906, with severe pneumonia, practically moribund. Temperature 103 to 104, pulse 140 to 160, respirations 32 to 70. Lived 48 hours after admission.

CASE 9.—M. W., aged 1, was admitted May 15, 1906, with pneumonia and extremely severe gastroenteritis. Patient was poorly nourished and apparently in dying condition. There were seven or eight stools daily, almost pure mucus. Temperature 98 to 102, pulse 140 to 200, respirations 30 to 80. Lived one week.

CASE 10.—W. M., aged 10 months, was admitted April 4, 1906. Double pneumonia, involving entire left lung and apex of right lung. Life despaired of daily for 10 days. Temperature 102 to 106, respirations 40 to 72, pulse 120 to 180 for six days, then 99 to 104 next nine days, and 100 to 103 next 10 days. Normal at end of fourth week. There was more or less gastrointestinal disturbance during entire four weeks. Child was discharged in good condition May 26, 1906.

CASE 11.—L. D., aged 1, was admitted April 5, 1906, desperately ill with double bronchopneumonia. Temperature ranged from 99 to 105 for four days, then dropped to normal. Next day temperature rose to 105, pulse to 180, respiration to 60, and remained high for six days, then dropped by lysis. In 24 hours temperature rose to 103, pulse to 170, respiration to 50. Temperature dropped again in seven days and remained normal. There was marked gastrointestinal disturbance during second and third week of illness. The patient was discharged perfectly well May 1, 1906.

ADMINISTRATION OF SALINES BY THE MOUTH.

The use of salines by the mouth has been employed by Dr. J. B. Todd, of Syracuse, who twice reported his experience.⁶ He gives convincing reasons for preferring the administration of salines in this way rather than by the surgical method of hypodermoclysis or the uncertain one of enteroclysis. He asserts rightly that it is not physiologic to crowd a large amount of salt into the tissues at one point and one time. A continued supply is vastly better from all standpoints.

Recently Garcia Y. Marin⁷ described his success in the employment of massive injections of normal salt solution in the treatment of typhoid fever. He claims that these large daily saline infusions amply fulfil the chief indications, which are (a) to destroy the etiologic factors; (b) to supplement natural defenses of the organism against infection, and (c) to favor elimination of toxic principles, the retention of which causes the typhoid states. His results were an increase of blood tension, augmentation of the quantity of urine, a transitory rise of temperature followed by reduction, abundant bowel discharges and profuse sweatings, excitation of the glandular functions and nervous forces.

6. N. Y. Med. Jour., May 20, 1905; also N. Y. Med. Record, April 14, 1906.

7. Le Jour. de Med. et Chir., Montreal, March, 1906.

DISCUSSION.

Dr. H. C. WORTHINGTON, Oak Park, Ill., said that he has always given mutton or chicken broth along with the food in the treatment of febrile cases, and he believes that stimulation has come from the salt in the broths. He believes that it is a thoroughly good thing to add these broths to the milk diet.

FOREIGN BODIES IN THE BRONCHI.

THEIR SUCCESSFUL REMOVAL WITH THE BRONCHOSCOPE.*

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There is such a variance in the character of the foreign bodies that find their way into the bronchi, and persons are so variably susceptible to their presence, some with slight complaints, others mortally ill, that the recital of individual experiences must surely help in the momentous decision we are called on to give. May we temporize, or must we act at once? To help in this elucidation is my reason for presenting my own observations of five cases seen in a little more than a year.

CASE 1.—On Jan. 24, 1905, in consultation with Dr. Sidney Yankauer of this city, I saw a ten months' old boy, who, while the juice of an orange was being insinuated into his mouth, inhaled one of the orange seeds. I responded promptly, arriving an hour after the accident; the child was coughing distressfully and markedly cyanotic. The coughing soon ceased and with it the breathing became freer.

Operation.—By my advice the child was taken to a hospital, tracheotomy done, and with my assistance the seed removed by Dr. Yankauer through the bronchoscopic tube. The child already showed signs of interference with vesicular breathing and pneumonia was threatened. Only prompt removal prevented that occurrence.

This case, which has been more fully reported,¹ is especially interesting in that it is the youngest patient thus far recorded as inhaling a foreign body with successful removal by means of the bronchoscope.

CASE 2.—A child, aged 6, patient of Dr. Charles A. Elsberg, swallowed a glass-headed pin. Dr. Elsberg kindly permitted me to attempt its location by direct bronchoscopy. I was unable to introduce the bronchoscopic tube successfully, nor did I persist in many attempts, as the child was already enfeebled by its coughing and distress. As the sequel showed, even if located, it could not have been extracted in the usual manner, for on introducing a large endoscopic tube through the tracheotomy wound the pin was seen lying crosswise, and it required much bending by powerful forceps to extract it. Complete recovery followed.²

CASE 3.—On Sept. 28, 1905, Dr. C. A. McWilliams, adjunct attending surgeon to the Presbyterian Hospital, informed me that he had a boy, aged 5, with a foreign body in the right bronchus, and as there were no bronchoscopic instruments in the institution he was in a quandary. I cheerfully offered my services, and, as the patient was then in a comfortable condition, an appointment was made for the following day, September 29, at 4 p. m.

History.—The following history was given: On September 26, three days previous, while he was playing with some beans, he came to his mother and said that he had swallowed one. He was slightly uncomfortable, but his mother was not alarmed

* Read in the Section on Laryngology and Otology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. Medical Record, Feb. 11, 1905.

2. Laryngoscope, December, 1905, p. 944.