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The Treatment of Tetanus

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BULLETIN OF THE
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INDEX

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I. THE TREATMENT OF TETANUS

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Following a masterful description of tetanus which has yet to be improved upon, Aretaeus remarked:

"But neither can the physician, though present and looking on, furnish any assistance as regards life, relief of pain or from deformity....with them then who are overpowered by this disease, he can merely sympathize..."[1] Eighteen centuries after his description we can feel less helpless when faced with treating this condition, but the ideal treatment has not been obtained.

Tetanus is endemic in Minnesota and is encountered at the University Hospitals with sufficient frequency to merit periodic reconsideration. It was thought profitable to review our cases on the neurology service in order to appraise the trends of treatment here and elsewhere.

Most of the current concepts of the pathogenesis agree that the development of the disease is dependent upon the organisms multiplying and producing a soluble toxin. It is this toxin that produces the symptoms.

The exact method by which the toxin reaches the nervous system is still controversial. The older theory of Myer assumed that the toxin passed along the peripheral nerve axes. This explained the fact that when the site of injury was more remote, the incubation period tended to be longer, and explained the phenomenon of local tetanus. However, a series of systematic and careful experiments by Abel and his coworkers[2] shows conclusively that the spread of the toxin is probably by the hematogenous route. Further evidence for a hematogenous spread comes from histological studies. It has been shown that a perivascular demyelination occurs if the disease has been present for five days or more[3]. Histologic as well as experimental studies support the contention that the symptoms in this disease may result from the involvement of certain groups of motor cells, probably accounting for the clonic spasms. Experimental evidence also suggests that in tetanus there may be some involvement of the myoneural junction, central synaptic mechanism, and the cholinesterase-acetylcholine system[4].

According to Abel's experiments, serum therapy is powerless to mitigate or abolish the lethal effect of the tetanus toxin once a certain dose has been fixed by the nervous system. On the basis of cross circulation experiments Firor[5] felt that this fixation of the toxin within the nervous system resulted in the production of a second toxin which would not respond to tetanus antiserum.

The ideal treatment therefore would be to combat the fixed toxin or to neutralize Firor's secondary toxin, if such exists. Such a therapeutic agent is not available.

Accordingly, the treatment has centered about controlling the manifestations and preventing their progression to a fatal issue.

A knowledge of the usual causes of death in this disease, therefore, is most essential to any consideration of treatment. In tetanus death usually results from one of five causes, namely:

1. Spasm of the glottis, diaphragm and intercostal muscles resulting in asphyxia.
2. Toxic encephalitis
3. Exhaustion
4. Medullary failure
5. Secondary pulmonary infection.

Table 1

CAUSES OF DEATH IN ELEVEN FATAL CASES
(Eight Autopsies)

Exhaustion and/or Medullary	Laryngeal spasm	Toxic Encephalitis	Pneumonia
8	5	3	4

In a number of our cases it was most difficult to distinguish between death from exhaustion and medullary failure. Often in both there occurred changes in pulse, respiration and temperature. It is our feeling that most fatalities which were considered due to exhaustion, actually were due to unrecognized medullary failure. Pathological studies in a number of our cases tend to lend proof to such a concept[5].

Our treatment has centered around measures to prevent the above complications and has included:

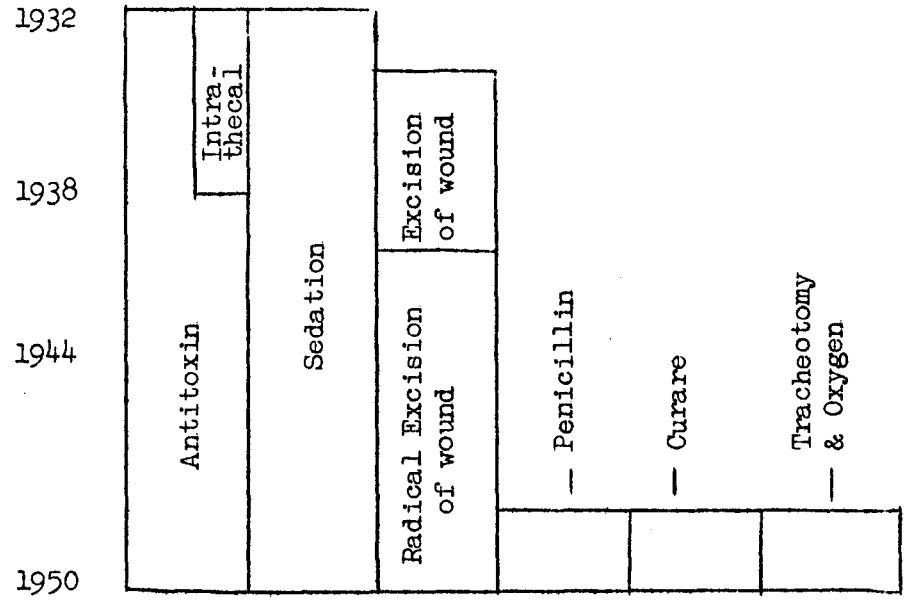
1. Excision of the wound of entry in order to prevent further toxin formation.
2. Neutralization of the circulating toxin.
3. Sedation.
4. Use of curare and curare-like drugs to combat muscle irritability.
5. Penicillin to combat secondary pulmonary infection.
6. Early tracheotomy to prevent asphyxia.
7. Oxygen therapy to help maintain medullary function.

In tetanus over a period of years, the trend of treatment has varied considerably. However, there has always been an apparent attempt to combat one or another of the various causes of death by current techniques. This trend in therapy can be readily visualized in Table 2 which summarizes the methods of treatment at the University of Minnesota Hospitals since 1932.

It might be well at this time to discuss the various treatment procedures in more detail in an attempt to point out from our experiences, those methods which are most applicable at this time. Excision of the Wound: Since the tetanus bacillus produces its toxin from a focal area, it would seem logical to radically remove the focus of infection and thereby prevent further manufacture of the toxin. Opinions in the literature as to the efficacy of this procedure have been controversial. A number of investigators[2,7] have observed experimentally that the course of the disease is not materially affected by excising the wound. Spaeth[8] believes that the risk of stimulating the patient is sometimes an important deterrant to this procedure. Kirtly, on the other hand, felt that excision was of great value and materially increased the likelihood of recovery. If the present concept of the pathogenesis of this disease is correct, then it would seem to us to be most essential to radically remove the focus of infection whenever such a focus can be found. Since 1938, we have tended to be more radical in our removal of the wound. It must be taken into consideration however, that there will be many cases in which no focus can be found and such patients will have to be treated without the apparent benefits of such a procedure.

Table 2

METHODS OF TREATMENT USED AT UNIV. OF MINN. HOSPITALS. 1932-1950



Neutralization of the Circulating Toxin: The extensive experiences with seroprophylaxis in World War I[9] confirmed clinically the experimental work of Kitasato[10] as to the beneficial effects of antiserum on the tetanus toxin. Opinion has differed with respect to use of serum once symptoms have developed. Experimentally it has been shown that once a lethal dose has been fixed by nervous tissue, antitetanic serum is powerless to mitigate the course of the disease[11]. Since, for practical purposes, it is impossible to determine if this has occurred clinically, it has been thought advisable to give adequate antitoxin to all patients suffering from this disease. Based on the results of serial titration specimens, Spaeth[12,8] has recommended as a reasonable schedule, the administration of 60,000 units during the first 24 hours and 20,000 to 40,000 units daily for the next few days.

With the newer tendency to radically remove the focus of infection it would not seem necessary to maintain a high serum level of antitoxin for any length of time. Where the wound is extensive and cannot be completely removed, or where the focus cannot be found, a larger dose and a longer period of administration would logically be indicated. In our cases the dosage has varied from 40,000 to 200,000 units daily over a period of from a few days to several weeks depending on these factors.

Intraspinal serum was used here prior to 1938 but has been gradually discarded because of the dangers incumbent in its use[13], and the lack of proof that it has any advantages over the parental route.

Sedation: Environmental and pharmacologic sedation has been repeatedly cited as the corner stone of treatment. Bryant and Fairman[14] treated 22 patients with sedation alone and had only five deaths--a very low rate and contrary to most reports in the literature. It was, parenthetically, of extreme interest to note the nature of Bryant's patients. They were natives of the Dinka District of Equatoria. The mode of entry of the organism differed not a little from the

more conventional portals. Penetrating spear wounds, crocodile bites, lion bites, and fish fin wounds were among those listed. All cases were given preliminary first aid dressing with cow dung prior to admission. The 22 cases were observed over a 6-month period.

Absolute quiet, a dark room and sedation have been considered of great importance in preventing and controlling the muscle hyper-irritability occurring in this disease. The most popular drugs for this purpose have been avertin, the barbiturates, chloral hydrate, and paraldehyde. The great disadvantage to these drugs is that in the more severe cases, doses which control the symptoms also greatly suppress respiration and predispose to respiratory infections. The barbiturates have been shown to reduce the life span of experimentally infected animals[5]. In many patients, however, the barbiturates, chiefly amytal, have proven very useful.

Paraldehyde, in our experience, has been one of the best drugs--administered rectally, orally, or intramuscularly with alternation of the routes because of its irritative properties. The dosage must be regulated according to the response of the patient and can frequently be reduced if curare and other such drugs are used concomitantly.

Curare and Curare-like Drugs: It is not surprising that Claude Bernard, who showed that curare had its primary action at the myoneural junction should have suggested that this substance be used in the treatment of tetanus. The first case was treated by Hoche[15] in 1894. Sporadic cases were reported in the literature but the method was greatly hindered by the lack of any standardization of the substance. Subsequent to the crystalization of a highly active d-tubocurarine chloride[16] in 1935 several papers have appeared[17,18,19] on its use in tetanus. Intravenous injection of the substance was reported to relieve the excruciating pain of the muscle spasms in a matter of seconds. To quote one author[19], "One could see the jaw relax, the opisthotonos disappear, and the respirations become easier".

Curare possessed certain theoretical advantages over the sedatives previously used since it permitted relaxation without the prolonged respiratory depression and interference with vegetative functions which was present with the usual sedatives. Since curare paralyzes the intercostals prior to the diaphragm it could at least theoretically release tonic fixation of the chest without complete paralysis of the respiratory musculature.

However, at the onset, the use of curare was somewhat impracticable, since it had to be given intravenously and its action was very short. This necessitated very frequent injections and continuous attention by the physician in order to combat toxicity and the side effects of hypersecretion and bronchospasm.

More recently, a suspension of curare in wax and oil, similar to that used by Romansky and Rittman[20] for penicillin has been used in the treatment of various spastic conditions by Schlesinger[21]. He observed no undesirable side effects in 1500 injections. Weed and Purvis[22] reported the use of this drug in three cases of tetanus. All of the patients had generalized muscular spasms and two of the three had tetanic convulsions. The authors used a preparation (SQUIBB) containing 175 units of d-tubocurarine in 4.8% wax and oil. The dosage of the drug varied between 0.75 and 2.0 cc daily. The effect from one intramuscular injection was apparent within an hour and lasted about twenty hours. They encountered no serious toxic effects. EKG's were normal and no clinical cardiac dysfunction occurred. All the patients lived.

We have used curare in the treatment of three cases. While in all the cases there seemed to be some subjective relief, in only one case was it possible to form any definite conclusions. In case #2 it was felt that the amount of sedation required was considerably reduced by the

concomitant use of curare.

Godman and Adriani[23] have recently reported some success with myanesin although their dosage seems to be exceedingly small. On the neurology service of the University Hospitals, in an occasional case, a combination of curare and pentothal, known as Baird's solution[24] has been used. This solution is an attempt to combine the relaxing effects of the sedatives with that of the curare-like drugs.

Penicillin: A knowledge that penicillin inhibited growth of clostridium tetani naturally stimulated interest in the effect of the antibiotic on the disease. It is generally agreed that the organism remains at the site of the wound, multiplies, and produces its toxin locally. However, recovery of the organism from various organs in four fatal cases by Mayer indicates that a bacteremia may occur. The experiments of Neter[25] would seem to show that the antibiotic fails to protect animals against the toxin itself.

Several reports of small series of patients treated with penicillin[26,27,28,29] have been published with statements that in the cases discussed the drug "would seem" to be or "is apparently" life saving or beneficial. All were uncontrolled cases and one cannot draw any conclusions from them. Altemeier[30] reported 16 cases in which the drug had no effect. In 59 cases Diaz Rivera[31] and his coworkers reported some benefits from penicillin; however, the difference in mortality between the treated and untreated cases was less than 3% and is therefore of questionable significance.

Generally it appears that penicillin has very little effect upon the disease itself. However, the use of this drug is of utmost importance in combating the secondary pulmonary complications that often prove fatal to the patient. It is for this purpose that we have instituted the routine use of penicillin in all cases of tetanus admitted within the past few years.

Tracheotomy and Oxygen Therapy: In 1942 Baker[6] demonstrated marked nerve cell changes in certain cell groups in the medulla in tetanus. While the clinical signs and the mode of death in this disease had often seemed consistent with medullary failure, and Firor[5] had noted that his experimental dogs appeared to die primary respiratory deaths, this cause had previously been given little consideration. Moreover, even under the best regulation of sedation it is often impossible to totally avoid acute laryngospasm which acts as a constant threat of death from asphyxia and can seldom be averted by intubation because of the coincident trismus.

Primary vital medullary center involvement in poliomyelitis has been observed and described on our service several times in the last three years[32, 33]. Superimposed hypoxia which resulted from partially obstructed airways has always been followed by more marked and frequently irreversible involvement. We have been convinced that the institution of early tracheotomy and supplemental oxygen therapy have been of great value in preventing this occurrence.

It is reasonable to suppose, by analogy to poliomyelitis, that hypoxia would also have a detrimental effect on diseased nerve cells in tetanus. Accordingly within the past year we have instituted early tracheotomy in order to avoid hypoxia to the medulla and to insure an adequate airway in the event of spasm of the laryngeal muscles. Also the presence of a tracheotomy facilitates the administration of continuous oxygen, thus giving an added safety factor. We wish to emphasize the early and elective nature of this procedure.

Conclusions

In view of the above discussion it is our feeling that the most effective treatment of the tetanus patient at the present time should include the following points:

1. Environmental Sedation: The patient should be placed in a cool, dark room,

situated in that part of the ward most remote from extraneous noises. Furniture and bedclothing should be kept at a minimum; visitors should be forbidden. A special nurse should be in constant attendance. Nursing care in tetanus will be described in detail in a forthcoming publication from the Division of Neurology[34].

2. Pharmacologic Sedation: While this may be induced with any one or more of a variety of drugs, we have preferred paraldehyde because the degree of sedation is easily controlled and complications accompanying its use are few. A standard dosage cannot be prescribed, but will depend upon the clinical response of the patient, making frequent observation of the patient by the attending physician mandatory.

3. Excision of the Wound: The wound should be completely and widely excised, preferably under general anesthesia to avoid precipitation of spasms. The tissue surrounding the wound should be infiltrated with antitoxin immediately prior to surgery. Pentothal is probably the anesthetic of choice since the excitement phase of induction is eliminated and adequate oxygenation is maintained.

4. Antitoxin: Immediately after the diagnosis has been made the patient should be tested for sensitivity to horse serum and antitoxin administration begun, the initial dosage depending upon his response to the sensitivity tests. We feel that at least 100,000 units should be administered by the intravenous route daily for the first 2-3 days. Subsequent dosage will depend upon whether or not the physician feels that the focus of infection has been completely surgically irradicated. If he feels that excision was incomplete, that there may be other foci, or if no focus was found, then large daily dosage should be continued until the illness is terminated.

5. Early Tracheotomy: Tracheotomy should be performed at the first evidence of tonic spasms. It should never be delayed until the patient has periods of apnea and cyanosis, for the added effect of hypoxia upon the diseased nervous system may produce irreversible medullary damage. Oxygen should be administered under positive pressure through the tracheotomy tube during the acute phase of the illness. Frequent removal of secretions by section through the tube is usually necessary.

6. Penicillin: Penicillin is given in order to prevent pulmonary infections. What constitutes adequate dosage is speculative. However, we give approximately one million units daily in divided doses.

7. Curare: We feel that the administration of drugs with a curare-like action is definitely effective in promoting muscular relaxation and reducing the quantities of sedative drugs required. The best drug available to date is d-tubocurarine in oil. There is individual variation in adequate dosage depending upon the size of the patient, severity of muscular spasm, etc. On the average, we have found that approximately 1.5 cc injected once daily produces considerable relaxation without toxic symptoms. An ampule of prostigmine should be kept in the room and ready for immediate use at all times in the event that the patient becomes overcurarized.

8. Miscellaneous: Supportive therapy must of course be carried out as with any acutely ill patient. It should be pointed out that insertion of the gastric tube for feeding purposes should never be attempted unless tracheotomy has previously been performed because of the danger of exciting laryngospasm. If tracheotomy has not been performed, a syringe with pentothal of amytal should be kept constantly available in the event that the patient has a sudden spasm of the laryngeal muscles or those of the thoracic cage.

Although our present experience with all of the above treatment procedures is limited, still we feel that their application in the patients treated by us dur-

ing the past year has indicated their efficacy.

Table 3

MORTALITY IN RELATION TO TYPE OF TREATMENT

Type of Treatment	No. of Cases	Mortality %
Sedation & Antitoxin	12	67
Sedation, Antitoxin & Excision	7	60
Sedation, Antitoxin, Excision & Penicillin	2	50
Sedation, Antitoxin, Excision, Penicillin, Curare, and Tracheotomy	3	33

Two of the last patients treated were extremely ill for a long period of time and still survived. The only fatality during the past year was a patient who was in extremis on admission and in whom we did not have the opportunity to apply the above methods. Obviously it will take a large series of cases to completely justify our optimism with the above suggested methods of treatment. Nevertheless, we cannot help but feel that we have made great strides in the handling of these patients and that more rigid attention to the medullary complications by means of tracheotomy and oxygen therapy will help reduce the fatalities in this disease.

CASE REPORTS

Case 1.

, a 61-year old male, was admitted to the University Hospitals on Oct. 10, 1948. One week before, while walking through the city dump, he sustained a puncture wound on the sole of the right foot. This healed promptly. The day prior to admission he noticed that his jaw muscles were slightly stiff and the next morning he was unable to open his mouth enough to eat breakfast. He was hospitalized immediately. Examination revealed a marked trismus and moderate stiffness of the muscles of the back, neck and abdomen. There was a small healed wound on the sole of the right foot. A diagnosis of tetanus was made. The old puncture wound was excised. He received 200,000 units of tetanus antitoxin intravenously in three divided doses on the day of admission. Sedation was obtained with sodium luminal. He apparently was doing well until the morning of the second day when he was found to be very dyspneic and cyanotic. An attempt was made to insert an airway but the mouth could not be opened. An emergency tracheotomy was performed. Respirations ceased during the procedure and artificial respiration was given. However, no heart sounds were audible at the completion of the operation. Intracardiac adrenalin was administered without effect. Postmortem examination revealed mild pulmonary edema, but otherwise nothing of significance.

Case 2.

, an 18-year old white boy was admitted to the University Hospitals on the psychiatric service on Jan. 4, 1949. He gave a history of having stiffness and soreness of the jaws for three weeks. Two weeks prior to admission he experienced an episode of sudden generalized rigidity of the entire body. This was accompanied by profuse perspiration and lasted about 30 seconds. Since then these episodes recurred with increasing frequency lasting from $\frac{1}{2}$ to 4 minutes. He was told that they occurred during sleep. There was no history of injury. Because of the bizarre nature of his complaints and his seemingly emotional instability, he was admitted on the psychiatric service for study. Physical examination showed generalized muscular rigidity. During examination he had several episodes of more marked rigidity and assumed the opisthotonus position. These episodes lasted from 30 to 60 seconds. During the subsequent four days on the psychiatric service his condition remained unchanged. He was seen by the neurological consultant who noted the following: "risus sardonicus", trismus, rigid-

ity to the abdominal musculature, and profuse perspiration. Efforts to examine the patient produced generalized muscular spasms. A diagnosis of tetanus was made and he was transferred to the neurological service for treatment. A small crusted abrasion was noted on the left elbow and this was excised. No signs of infection were present. He was given 200,000 units of tetanus antitoxin intravenously daily and 100,000 units of penicillin every three hours. He was given d-tubocurarine in oil intramuscularly, in doses of from 1 to 1.5 cc. daily. Sedation was obtained with paraldehyde, avertin and sodium amytal. During the next three days his temperature rose to 103 degrees and there were several episodes of generalized muscular spasms during which he was cyanotic and had gasping respirations. There was a copious outpouring of mucous in the posterior pharynx which required continual suction. A tracheotomy was performed in order that a continuous adequate airway might be maintained. Oxygen was administered under positive pressure through the tracheotomy tube. Thereafter the patient was kept well sedated and although at times there was moderate rigidity of the abdominal muscles he had no more spasmodic seizures and no further respiratory difficulty. He slowly improved, the tracheotomy tube was plugged on the 19th day and removed on the 24th day. He was discharged on the 33rd day apparently completely recovered.

Case 3.

, A 42-year old farmer was admitted to the University Hospitals on December 14, 1948. Two weeks before he sustained a compound fracture of the left index finger. At that time he was tested and found to be sensitive to tetanus antiserum. Therefore, no tetanus antitoxin was given for prophylaxis. Four days prior to admission he noticed stiffness of the jaws which increased during the next three days and he developed rigidity of the abdominal muscles. He was seen by his local doctor and referred to this hospital. Examination revealed marked trismus, moderate rigidity of the abdominal and neck muscles, and rigidity of the back. There was evidence of infection in the wound of the left index finger. A diagnosis of tetanus was made and treatment instituted. The left index finger was amputated. Sensitivity tests to tetanus antitoxin were positive, therefore desensitization was carried out with gradually increasing doses of antitoxin. Thereafter he received 100,000 units of antitoxin intravenously each day. He was given 200,000 units of penicillin every four hours and d-tubocurarine in both aqueous solution and in oil. The dosage and intervals of administration varied considerably, depending upon the degree of muscular rigidity present. Sedation was obtained with paraldehyde, chloral hydrate, avertin, and sodium pentothal. The patient appeared to be well sedated. There were occasional periods of generalized muscular rigidity. On the 6th day he became comatose and failed to respond to any but very painful stimuli. The musculature was relaxed and he was perspiring profusely. Sedation was discontinued and within a few hours the patient regained consciousness. During the next two weeks his course was very stormy. There were many episodes of spasmodic seizures in spite of heavy doses of sedatives. There were periods of very rapid irregular respirations with intermittent apnea. The pulse went as high as 150 and the temperature to 104 degrees. On the 21st day the pulse and temperature fell rather rapidly to normal and thereafter he slowly improved. He was discharged on the 34th day.

Case 4.

, A 63-year old white woman was admitted to the University Hospitals on May 18, 1949. Five weeks before she had caught her hand in the wringer of a washing machine but the skin had apparently not been broken. Ten days before admission she burned her hand on a stove with resulting charring of the skin. The day before admission she noticed stiffness of her jaws. On the morning of admission there was some difficulty in swallowing. Examination at the time of admission revealed marked nuchal rigidity and trismus. There was retraction of the facial

musculature giving a typical "risus sardonicus". There was rather marked rigidity of the muscles of the abdomen and back. A diagnosis of tetanus was made and treatment started immediately. She was given 200,000 units of tetanus antitoxin intravenously each day, 300,000 units penicillin every eight hours, and was sedated with paraldehyde. She also received d-tubocurarine in oil, the dosage being from 1.2 to 1.4 cc. daily. On the second day the patient began having opisthotonic seizures and respirations became labored with periods of apnea. Her temperature had risen from normal to 102 degrees. Sedation was increased and for the next two days muscular spasm seemed to be well controlled. Respirations were still irregular and rapid with apneic intervals. On the 5th day an attempt was made to pass a nasal tube for feeding purposes. This procedure precipitated a severe laryngeal spasm and there was a period of cyanosis for $1\frac{1}{2}$ minutes. The spasm was relieved by the administration of 4 cc. of Baird's solution intravenously. For the remainder of this day and the next she was unresponsive, had rapid irregular respirations with long periods of apnea and the pulse had increased to 130 per minute. She had short episodes of generalized muscular rigidity, but was rather relaxed most of the time. There was a large amount of mucous pooled in the posterior pharynx requiring frequent suctioning. On the 6th day respirations became shallow and gasping, pulse rose to 140, and she was perspiring profusely. Intravenous coramine and aminophylline were administered. Pulse became weak and respirations ceased. Artificial respiration was of no avail. Postmortem examination revealed the presence of mild pulmonary congestion. Microscopic sections of the brain revealed minimal changes compatible with a toxic encephalitis.

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II. MEDICAL SCHOOL NEWS

Coming Events

December 9 - Annual meeting of the Minnesota Medical Foundation, Campus Club, Coffman Memorial Union, 6:30 p.m.

December 16-17 - Continuation Course in Obstetrics for General Physicians.

January 5-7 - Continuation Course in Cardiovascular Diseases for General Physicians.

January 6 - Clarence M. Jackson Lecture, Tinsley R. Harrison, Southwestern Medical College, Dallas, Texas - "The Evaluation of Cardiac Murmurs" - 8:30 p.m., Medical Science Amphitheater.

* * *

Faculty News

Dr. Owen H. Wangensteen and the Department of Surgery were hosts to the members of the Halsted Club at its annual meeting on the campus of the University of Minnesota, December 2 and 3. This meeting brought to our campus distinguished scientists in surgery and related fields. Dr. Wangensteen was the Minneapolis host for the club which rotates its meeting place through various medical schools.

Dr. Harold S. Diehl, Dean of the Medical School, is at present in Great Britain where he is studying the effects of the British National Health Act on medical education. The American Medical Association asked Dr. Diehl to join with Dr. Loren R. Chandler, Dean of the Stanford University Medical School, and Dr. Stanley E. Dorst, Dean of the University of Cincinnati Medical School, in making this study. The visit will afford Dr. Diehl an opportunity to observe British medical education at first hand. Dr. Diehl is expected to return to the campus in three or four weeks.

The Travel Club of the American Gynecological Society met on the campus of the University of Minnesota on December 5. Dr. John L. McKelvey, Chief of the Department of Obstetrics and Gynecology, was host for the group. Clinical and full-time members of the faculty of the University presented papers before the group. Members of the Travel Club are teachers and investigators in the field of obstetrics and gynecology throughout the United States.

* * *

We wish to remind all physicians that they are welcome at all of the conferences, rounds, clinics, and seminars, which are listed each week in the Calendar of Events of the Bulletin. Most of the meetings occur regularly each week at the announced hour; meetings which do not are indicated.

Increasing numbers of practicing physicians are attending and participating in the various conferences, especially those in the clinical fields. We feel that practicing physicians have a real contribution to make to many of these conferences, and we are especially happy to find them taking time from their busy professional activities to join with us at the medical school and the affiliated hospitals.

* * *

The editor of the Bulletin will welcome news of University of Minnesota Medical School alumni which would be of interest to our readers. Such news may be sent directly to the editor at the University of Minnesota Hospitals.

III. UNIVERSITY OF MINNESOTA MEDICAL SCHOOL
CALENDAR OF EVENTS

December 11 - December 17, 1949

No. 268

Sunday, December 11

9:00 - 10:00 Surgery Grand Rounds; Station 22, U. H.

10:30 - 11:00 Surgical Conference; Bacteremia after T.U.R.; M. J. Feeney; M-109, U. H.

Monday, December 12

8:00 - Fracture Rounds; A. A. Zierold and Staff; Ward A, Minneapolis General Hospital.

9:00 - 9:50 Roentgenology-Medicine Conference; L. G. Rigler, C. J. Watson and Staff; Todd Amphitheater, U. H.

9:00 - 10:50 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff; M-109 U. H.

10:00 - 12:00 Neurology Rounds; A. B. Baker and Staff; Station 50, U. H.

11:00 - 11:50 Roentgenology-Medicine Conference; Veterans Hospital.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Eustis Amphitheater, U. H.

12:15 - 1:20 Obstetrics and Gynecology Journal Club; Staff Dining Room, U. H.

12:30 - 1:20 Pathology Seminar; Adrenal Dysfunction in Children; W. Eberlein; 104 I. A.

12:30 - 1:30 Surgery Problem Case Conference; A. A. Zierold, C. Dennis and Staff; Small Classroom, Minneapolis General Hospital.

1:30 - 2:30 Surgery Grand Rounds; A. A. Zierold, C. Dennis and Staff; Minneapolis General Hospital.

1:30 - 2:30 Pediatric-Neurological Rounds; R. Jensen, A. B. Baker and Staff; U. H.

4:00 - Public Health Seminar; Subject to be announced; 113 Medical Science.

4:00 - Pediatric Seminar; Serum Mucoproteins and Hyaluronidase Inhibitors in Healthy and Diseased Children; V. Kelley; 6th Fl. W., Child Psychiatry, U. H.

4:00 - Medical-Surgical Conference; Physiology of Potassium; Drs. Stutzman and Heller; Main Conference Room, Bldg. I, Veterans Hospital.

5:00 - 5:50 Clinical-Medical-Pathologic Conference; Todd Amphitheater, U. H.

5:00 - 6:00 Urology-Roentgenology Conference; D. Creevy, O. J. Baggenstoss and Staffs; M-109, U. H.

Monday, December 12 (Cont.)

8:00 p.m. - Clinical Research Club Meeting: 1) Effect of Desoxycorticosterone on the Alarm Response; B. Zimmerman (Dept. of Surgery) and C. Williams (Dept. of Medicine); 2) Recent Experiments in Detection of Tissue Density and Thickness Changes by Ultrasonics; John Wild (Dept. of Surgery); Eustis Amphitheater, U. H.

Tuesday, December 13

8:00 - 9:00 Fracture Conference; Auditorium, Ancker Hospital.

8:15 - 9:00 Roentgenology-Surgical-Pathological Conference; Craig Freeman and L. G. Rigler; M-109, U. H.

8:30 - 10:20 Surgery Seminar; Small Conference Room, Bldg. I, Veterans Hospital.

9:00 - 9:50 Roentgenology Pediatric Conference; L. G. Rigler, I. McQuarrie and Staffs; Todd Amphitheater, U. H.

10:30 - 11:50 Surgical Pathological Conference; Lyle Hay and E. T. Bell; Veterans Hospital.

12:30 - Pediatric-Surgery Rounds; Sta. I, Minneapolis General Hospital; Drs. Stoesser, Wyatt, Chisholm, McNelson and Dennis.

12:30 - 1:20 Pathology Conference; Autopsies; J. R. Dawson and Staff; 102 I. A.

1:00 - 2:30 X-ray Surgery Conference; Auditorium, Ancker Hospital.

2:00 - 2:50 Dermatology and Syphilology Conference; H. E. Michelson and Staff; Bldg. III, Veterans Hospital.

3:15 - 4:20 Gynecology Chart Conference; J. L. McKelvey and Staff; Station 54, U. H.

3:30 - 4:20 Clinical Pathological Conference; Staff; Veterans Hospital.

4:00 - 5:00 Pediatric Rounds on Wards; I. McQuarrie and Staff; U. H.

4:00 - 5:00 Physiology-Surgery Conference; Selected Surgical and Physiological Topics; Drs. Wangensteen and M. B. Visscher; Eustis Amphitheater, U. H.

5:00 - 6:00 X-ray Conference; Presentation of Cases by Ancker Hospital Staff; Dr. Aurelius et al; Todd Amphitheater, U. H.

Wednesday, December 14

8:00 - 8:50 Surgery Journal Club; O. H. Wangensteen and Staff; M-515, U. H.

8:30 - 9:30 Clinico-Pathological Conference; Auditorium, Ancker Hospital.

8:30 - 10:00 Orthopedic-Roentgenologic Conference; Edward T. Evans; Room 1AW, Veterans Hospital.

8:30 - 12:00 Neurology Rehabilitation and Case Conference; A. B. Baker, Veterans Hospital.

11:00 - 12:00 Pathology-Medicine-Surgery Conference; Surgery Case; O. H. Wangensteen, C. J. Watson, and Staffs; Todd Amphitheater, U. H.

Wednesday, December 14 (Cont.)

11:00 - 12:00 Electrocardiography Lecture; Unipolar Electrocardiography; Dr. Simonson; Main Conference Room, Veterans Hospital.

12:00 - 1:00 Radio-Isotope Seminar; Review of Current Literature on Radio-Active Isotopes; H. C. Mellins; 113 Medical Sciences.

3:30 - 4:30 Journal Club; Surgery Office, Ancker Hospital.

4:00 - 5:00 Infectious Disease Rounds; General Hospital, Basement Amphitheater.

5:00 - 5:50 Urology-Pathological Conference; C. D. Creevy and Staff; E-101, U. H.

Thursday, December 15

8:30 - 10:20 Surgery Grand Rounds; Lyle Hay and Staff; Veterans Hospital.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; M-109, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:50 Surgery-Radiology Conference; Daniel Fink and Lyle Hay; Veterans Hospital.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Todd Amphitheater, U. H.

11:30 - 12:30 Clinical Pathology Conference; Steven Barron, C. Dennis, George Fahr, A. V. Stoesser and Staffs; Large Classroom, Minneapolis General Hospital.

1:00 - 1:50 Fracture Conference; A. A. Zierold and Staff; Minneapolis General Hospital.

2:00 - 3:00 Errors Conference; A. A. Zierold, C. Dennis and Staff; Large Classroom, Minneapolis General Hospital.

4:30 - 5:20 Ophthalmology Ward Rounds; Erling W. Hansen and Staff; E-534, U. H.

5:00 - 6:00 X-ray Seminar; Cardiovascular Pulsations in Congenital Heart Disease; Joseph Jorgens; Todd Amphitheater, U. H.

Friday, December 16

8:30 - 10:00 Neurology Grand Rounds; A. B. Baker and Staff; Station 50, U. H.

9:00 - 9:50 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:20 Medicine Grand Rounds; Veterans Hospital.

10:30 - 11:50 Otolaryngology Case Studies; L. R. Boies and Staff; Out-Patient Department, U. H.

11:00 - 12:00 Surgery-Pediatric Conference; C. Dennis, O. S. Wyatt, A. V. Stoesser and Staffs; Minneapolis General Hospital.

11:45 - 12:50 University of Minnesota Hospitals General Staff Meeting; Iron Metabolism in Liver Disease; Robert Howard; Powell Hall Amphitheater.

Friday, December 16 (Cont.)

12:00 - 1:00 Surgery Clinical Pathological Conference; Clarence Dennis and Staff; Large Classroom, Minneapolis General Hospital.

1:00 - 1:50 Dermatology and Syphilology; Presentation of Selected Cases of the Week; H. E. Michelson and Staff; W-312, U. H.

1:00 - 3:00 Pathology-Surgery Conference; Auditorium, Ancker Hospital.

1:00 - 2:50 Neurosurgery-Roentgenology Conference; W. T. Peyton, Harold O. Peterson and Staff; Todd Amphitheater, U. H.

3:00 - 4:00 Neuropathology Conference; F. Tichy; Todd Amphitheater, U. H.

4:00 - 5:00 Clinical Pathological Conference; A. B. Baker; Todd Amphitheater, U. H.

4:00 - 5:00 Electrocardiographic Conference; George N. Aagaard; 106 Temp. Bldg., Hospital Court, U. H.

5:00 - 6:00 Otolaryngology Seminar; Review of Current Literature; Dr. Wheeler; Todd Memorial Room, U. H.

Saturday, December 17

7:45 - 8:50 Orthopedics Conference; Wallace H. Cole and Staff; M-109, U. H.

8:00 - 9:00 Pediatric Psychiatric Rounds; Reynold Jensen; 6th Floor, West Wing, U. H.

8:00 - 9:00 Surgery Literature Conference; Clarence Dennis and Staff; Small Classroom, Minneapolis General Hospital.

8:30 - 9:30 Surgery Conference; Auditorium, Ancker Hospital.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; E-221, U. H.

9:00 - 10:30 Pediatric Grand Rounds; I. McQuarrie and Staff; Eustis Amphitheater, U. H.

9:00 - 11:30 Surgery-Roentgenology Conference; Todd Amphitheater, U. H.

9:00 - 11:30 Psychiatry Conference; Specific Learning Disabilities of Children; University Hospitals.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:00 - 12:50 Obstetrics and Gynecology Grand Rounds; J. L. McKelvey and Staff; Station 44, U. H.