FIVE YEARS' EXPERIENCE WITH HEMODRADIATION
ACCORDING TO THE KNOTT TECHNIC

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In May, 1940, the author published a report on this method in 110 cases which he had treated in a period of about eighteen months. The material represented twenty-nine different conditions. Since that time other investigators have published a number of papers on the subject, the total, with the present paper amounting to fourteen. The writer has treated over 400 persons with this method during the last five years, and the present article sets forth some of the interesting findings which he and other workers have observed in connection with this radical departure from conventional methods of ultraviolet therapy. Nine illustrative cases are presented.

A comparison with the older methods is natural and inevitable. The ultraviolet radiologist has long recognized the difficulties attending the administration of this form of radiant energy arising from the great variability in important factors. The skin, it is hardly necessary to point out, offers a considerable problem by virtue of the variations met with, such as thickness, natural color and pigmentation, degrees of hematization, etc. In addition to these factors there are the inherent faults of the skin as a receptor for ultraviolet radiation, as for example the variation in sensitivity and its susceptibility to radiation injury. Notwithstanding these natural handicaps which interfere with efforts to utilize the skin as a medium for the absorption of ultraviolet energy, much has been accomplished in using it in the therapy of numerous conditions.

Some of the achievements of ultraviolet ray therapy in infections prior to hemo-irradiation are: Lupus vulgaris, a tuberculous disease of the skin and membranes was first successfully treated by Neils Finsen with a special arc lamp of his design as long ago as 1897. Up to the year 1910, at the Finsen Institute in Copenhagen, Finsen and his successors had treated 2,000 patients with a recovery of 98 per cent. We still have lupus vulgaris with us. The author saw a case recently in which the greater part of the skin of the face was covered with the lesions; one eye had been invaded, the sight destroyed and the lids of the other were involved. Strange-ly, no one had used the Finsen technic or even a modification of it.

Extrapulmonary tuberculosis or surgical tuberculosis of bones, joints, peritoneum, etc., is another field in which ultraviolet radiation is pre-eminent. Dr. Cecil Rowntree, Hunterian Professor of Surgery, Royal College of Surgeons, asserts, "The treatment of tuberculous disease of the bones has fortunately undergone a revolution in recent years for the drastic and crippling operations are now replaced by a regime which includes complete rest of the affected part and very conservative and limited surgical operation for the purpose of evacuating abscesses combined with sunlight treatment, real or artificial. When persevered with, such methods almost always effect a cure in every case."

Erysipelas. A few physicians employed ultraviolet radiation for this condition in the 1920's with success and Walter H. Ude, Radiologist to the Minneapolis General Hospital, reported a series of 100 cases in 1929, claiming for ultraviolet energy practically specific action in his series. This was substantiated by an increasing number of observers and the agent came into general
use during the next decade. It has been largely eclipsed by the introduction of the sulfa drugs which are easier to administer.

These examples of the effectiveness of ultraviolet radiation therapy—in the hands of competent therapists—are cited to give some indication of the potency of this form of radiant energy. The same kind of spectral energy is employed in the Knott technic, in a very different manner, however, from conventional methods.

With the Knott technic there is very little variability in the important factors involved. A definite amount of blood is removed from a vein, citrated and immediately returned to the blood stream via the Knott hemo-irradiator which consists essentially of a pump, an ingeniously designed irradiation chamber, a water-cooled mercury quartz lamp and a mechanism for controlling the rate of flow of the blood through the circuit and consequently the irradiation time. Accurate dosage, the one outstanding factor in the effectiveness of ultraviolet radiation therapy, is finally achieved in this manner. There had been much reason to believe before Knott's work that the most important element concerned in ultraviolet radiation therapy was the blood; but a practical and efficient direct method had not been devised, as far as the author is aware, until Knott and his associates evolved the method of treating the blood that is proving so valuable in the treatment of infections and other conditions.

One of the most celebrated authorities on immunology, Sir Almroth Wright, (originator of the system of therapeutic innoculation for bacterial infection and of methods for measuring the protective substances in the blood) in his article on Immunology in the fourteenth edition of the Encyclopaedia Britannica states as follows, "As has been shown in the irradiation of the skin with ultra-violet light, the light of the electric arc and sunlight that by these agencies also the bactericidal power of the blood is increased, such bactericidal power depending upon the increased phagocytic power of the leucocytes and also upon the increased antibacterial power of the serum. It is not yet known how irradiation produces these results. Increased bactericidal power is achieved only with certain quanta of irradiation and the blood suffers deterioration when larger doses are employed."

Other recognized authorities have similarly expressed themselves as for example Sir Henry Gauvain, Sir Leonard Hill, Sir Walter S. Lazarus Barlow et al.

There has been a good deal of investigation into the effect of ultraviolet energy on various constituents of the blood, normal and abnormal (bacteria, toxins, etc.). Other writers on hemo-irradiation have given some of the important references in their bibliographies.

To those bacteriologists and others whose experience with ultraviolet energy has been largely confined to experiments consisting in the exposure of petrie dish cultures to various sources of ultraviolet radiation and to x-rays, it is only fair to point out something that has apparently escaped many such an investigator, namely, the vast difference between inert gelatine and living reacting animal tissues.

The problem presented by the Knott technic is this: Granted for sake of argument that bacteria are readily killed under certain conditions by ultraviolet energy, granted also that they are killed if present in the blood of a patient when some of this blood passes through the irradiation chamber, and that toxins are inactivated also, how is one to explain the apparent effects on the balance of the blood not treated (191 to 19,000 of the blood volume)? It has been suggested that the irradiated portion carries the primary ultraviolet rays into the untreated portion of the blood and that secondary radiation is produced in this; but the author cannot entertain this theory from the point of view of the radiologist with any great enthusiasm. The initiation of chain photochemical reactions in the irradiated blood continued and in the unirradiated portion is probably the basis of the action. When we consider first of all
Physiological Effects Following Hemo-Irradiation in Infections and Toxemias

1. Reduction in Toxemia. This is demonstrated subjectively by improvement in the mental state and clarity of thinking and speaking which may take place within a few minutes following hemo-irradiation. By the following day reduction in toxemia is usually very noticeable, associated with an improvement in the sense of well being. Objectively, it is indicated by fall in temperature, diminution in the sedimentation time and improvement in the blood picture.

2. Improvement in the Blood Picture. There is a marked tendency for a restoration to normal levels of the various blood elements. With the reduction in the infective process there is a fall in the white count, with an increase in the young white cells. If the count has been low, due to poor response to the infection, it is frequently raised to an appropriate level for the severity of the infection. When leucopenia has been caused by certain drugs this is nearly always corrected. In the case of a secondary anemia, due to the two influences, destruction of red cells and inhibition of the red cell forming mechanism, there is a return to normal levels within a relatively short time. It will be noticed that some of the patients have received blood transfusions which may in some cases give a temporary boost to the red cells; but if the infection continues, this gain may be only transient. With a reduction of the toxemia following one or more hemo-irradiations, it is only natural that the blood picture should improve. That is one of the most consistent effects, and it is seen also uniformly in the less severe infections and in debilitated persons. The same effect is witnessed in the case of the hemoglobin. It is highly desirable to give patients blood transfusions and glucose when the blood is in serious condition and a prompt effect is imperative. There is no objection to transfusions and the records show that we have supplemented hemo-irradiation with these on numerous occasions. Every aid in desperate cases should be employed, but what we do wish to emphasize is the fact that many of our seriously ill patients have already had one or more transfusions (Case IV had seven), and these and other measures failing, hemo-irradiation was resorted to.

3. Improvement in the Peripheral Circulation. We have witnessed a great many times in cyanotic individuals a return to natural color even during the giving of the hemo-irradiation. In the case of the young woman with bronchopneumonia (Case VI) this was evident while she was still in the oxygen tent and receiving oxygen which was being given almost constantly, long before hemo-irradiation was contemplated. This change in color is due to an increase in the venous oxygen. The improvement in the temperature of the extremities and the sense of warmth that patients remark about is a very common effect associated with hemo-irradiation. Patients volunteer this information, and the improvement in the circulation in the hands and feet is maintained indefinitely. In some cases it may last for only a few days to be restored after a second irradiation, or it may persist for months or longer.

4. Relief of Pain. One of the most interesting effects is early relief of pain. This may take place even while the treatment, which takes only seven to twelve...
minutes, is in progress. At first the author believed that it was a psychological effect but it has occurred so many times, that is, the practically immediate relief, that it can no longer be explained on this basis. Within twenty-four hours relief is very common.

5. Improvement in the Appetite. (Cases II, v, VIII.) This is frequently a striking effect. There is cessation of nausea and a return of appetite taking place sometimes in twelve to twenty-four hours. This is commonly associated with a return to normal weight. Several of the cases described indicate the marked effect on the appetite and weight. The case of peritonitis (Case v) had a real zest for food in twelve hours. She gained fifteen pounds in fourteen days and twenty-six pounds in twenty-one. The patient with toxemia and debility (Case II) following eclampsia gained thirty-six pounds in seven weeks. The patient with superior inferior cerebellar artery thrombosis (Case IX) was forty-five pounds under normal weight when first seen and irradiated. He began immediately to gain, recovered forty-five pounds in about four months, and continued to gain so that in nine months he had put on fifty-five pounds.

Best results are obtained in infections in which the blood supply is good or moderately good, that is, in which the infection is not walled off to such an extent that the irradiated blood cannot enter the focus, as for instance in the case of an abscessed tooth. Toxemia and arthritis due to an abscessed tooth will be temporarily reduced, but in due course they will return if the tooth is not removed. It is desirable when several teeth are infected to irradiate the patient before extraction (Case VIII), and this can then be done safely at one time without fear of aggravating an associated arthritis or of producing a bacteremia. Healing of the sockets and gums is increased in rate if hemo-irradiation is given before or shortly after extraction.

Attention is called to the findings of Dr. E. W. Rebbeck in septic abortions.30 He found that preoperative hemo-irradiation diminished postoperative temperatures, and in none of the cases in which operation was done after hemo-irradiation did a transient bacteremia develop, but in some cases in which a dilatation and curettage were done without preoperative irradiation transient bacteremias did appear.

In peritonitis in which the blood circulation is good and in cellulitis the results are excellent. It is desirable, of course, to remove a focus of infection or drain surgically. We always urge that, but to repeat, it is a very excellent practice to give preoperative hemo-irradiation especially in severe cases of infection to insure a good postoperative convalescence with a minimum of discomfort and to prevent complications.

RESULTS OF HEMO-IRRADIATION IN INFECTIONS

1. E. K. Knott and V. K. Hancock reported the recovery of two apparently moribund patients in 1934, one a septicemia and the other a brain abscess.

2. H. A. Barrett reported 110 cases in 1940, including a number of infections. Twenty-nine different conditions are represented in this series. Among the conditions treated were the following: infectious arthritis, thirteen cases; osteo-arthritis, sixteen; tuberculosis glands, two; chronic blepharitis, four; mastoiditis, two; uveitis, one; furunculosis, three; chronic paranasal sinusitis, four; acne vulgaris, three; secondary anemias, eight. The results were very encouraging.

3. In a series of 151 consecutive unselected cases of acute pyogenic infections treated by George Miley at Hahnemann Hospital, Philadelphia, between November 1, 1938 and December 31, 1941, the recovery rate was 100 per cent in the early cases; in the moderately advanced eighty-one cases the rate was 98 per cent and in fifty-five apparently moribund patients the rate was 42 per cent. The series included eighteen cases of puerperal sepsis with eighteen recoveries; septic abortions, nineteen cases with seventeen recoveries; gen-
eralized peritonitis, seven cases with seven recoveries; four femoral thrombophlebitis cases with four recoveries, and seven pelvic abscess with pelvic peritonitis cases with seven recoveries. Of the 151 cases, fifty-seven were obvious chemotherapeutic failures. In the fifty-five apparently moribund patients there were twenty-six who received combined hemo-irradiation, and of these nine had bacterial endocarditis and seven had Staphylococcus aureus septicemia. If all the cases of bacterial endocarditis and Staphylococcus aureus septicemia are excluded, there are a total of thirty-one recoveries among forty-one cases of obvious chemotherapeutic failure which is about 75 per cent.

4. E. W. Rebbeck reported on ultra-irradiation of blood in the treatment of puerperal sepsis. Between July, 1937, and May, 1940, thirteen patients were treated with hemo-irradiation all of which recovered. There were six sulfa drug failures in this group. One patient showed non-hemolytic streptococcic positive blood cultures. All patients with puerperal sepsis now receive hemo-irradiation at Shadyside Hospital.

5. E. W. Rebbeck also reported on septic abortions. From July, 1938, to June, 1941, sixteen patients were treated in Shadyside Hospital, Pittsburgh, twelve preoperatively and four postoperatively. Of these seven were in a state of advanced morbidity when admitted and one had an indifferent streptococcus in the blood stream. In those instances in which this therapy was used postoperatively (in four cases with advanced morbidity) prompt relief of toxemia and decrease in fever were outstanding. Three patients had been given sulfanilamide. All the patients recovered.

6. Virgil K. Hancock reported four cases of hemolytic streptococcus blood stream infections, one colon blood stream with a temperature of 108.4°F. and a Staphylococcus albus blood stream infection complicated by osteomyelitis and bronchopneumonia. These patients were treated between 1933 and 1938. The total number of treatments was seventeen or an average of 2.3. He reported in the same paper five cases of Streptococcus viridans infection of the blood stream, three patients with endocarditis, all dying, and two without endocarditis who recovered.

7. Miley reported thirteen consecutive cases of acute thrombophlebitis with thirteen recoveries. In all thirteen cases a rapid disappearance of pain and tenderness was observed, usually within twenty-four to forty-eight hours. Five of the cases were chemotherapy failures. Edema subsided in twelve cases, the disappearance time varying from three to fifteen days. Local heat and bed-rest elevation of the extremity had been tried without success in a number of cases.

CASE REPORTS

Case 1. Infectious arthritis with uncontrollable perspiring. Physician, Dr. Hunter, Flushing, N. Y.

The patient had rheumatic fever in 1933 which left her joints so painful she could scarcely walk, for a month or so. Then she seemed to recover completely except for her heart which was temporarily affected but she seemed to recover from this after a time.

However, during the winter of 1937-1938 she developed a myocarditis and endocarditis. She had very severe night sweats and her weight fell off considerably to seventy pounds. A month before coming to me for an irradiation she had had a tooth extracted and a culture showed Streptococcus hemolyticus.

At the time of hemo-irradiation the patient looked weak and ill. She had been sent to me to see if irradiations would have any effect on the uncontrolled night sweats. She had been under several physicians for this, but no definite cause was found and all medication failed. The patient stated that she had to remove or change the bed linen three and four times nightly summer and winter. She had in addition to this polyarthritis which was moderately severe, but it was because of the sweating she had come to the author.

The patient was given five irradiations in all. The first treatment was given on a Saturday, June 24, 1938. On Sunday morning the patient phoned to say that she had perspired only about half the usual amount and that she felt
better. The perspiring diminished still more
the following night and became progressively
less. When she came for her second irradiation
for a period of three months, her health was in
a wretched state. She was weak, lacked an
appetite, and could not regain her lost weight,
in which there was acidosis by ultraviolet radiation and even after the onset of convulsions and treated in the early stages

Examination revealed a pinkish purulent discharge in the vagina originating from the endocervix. The cervix was slightly soft, not

done developed serious complications. In Case II, there is no question of the marked benefit to the health following irradiations on three separate occasions associated with three pregnancies, in the same individual. No claim is made for hemo-irradiation for toxemias of pregnancy on the basis of this one case, but the author believes the method deserves further investigation in this class of toxemias.

Case III. Abortion followed by sepsis.*

Chemotherapy failure.

A nineteen year old white female was admitted for vaginal bleeding on November 21, 1939. She stated that in February, 1939, she was delivered of a seven month’s living premature infant by forceps. Her first menstrual period returned on October 12th and lasted one and one-half days. Following that period she thought she was pregnant, so she pushed her finger into her uterus on November 12th and began bleeding with passage of clots. She continued bleeding until admission. On the morning of admission she had a chill. She appeared acutely ill. Her temperature was 100°F., pulse 104, respirations 24.

* History of case taken from hospital records of City Hospital, Welfare Island.

patulous. It was retrodisplaced, normal in size, the adnexa was not outlined but there was a sensation of masses in both regions. Her temperature ranged between 99 and 102.6°F., for the first two days. Cervical and urethral smears were positive for gonococcus and the patient was placed on sulfanilamide on November 25th. Her temperature remained at 99°F. for three days but on November 28th after she had received 180 gr. of sulfanilamide she became cyanotic and had a chill with a temperature of 103.6°F., so this drug was discontinued. The patient then began running a septic temperature up to 105.6°F. Seventy gr. of sulfanilamide were given on December 2nd and again discontinued.

On December 3rd the patient was given a 500 cc. blood transfusion. Her temperature on December 4th at 2:30 P.M. was 106.4°F. following a chill. All blood cultures were negative.

Hemo-irradiation was ordered and 130 cc. of the patient’s blood was irradiated and re-injected. The temperature fell by crisis on the following day and remained normal except for a rise to 100°F. on December 10th which promptly returned to normal. A catheterized urine examination on December 28th was negative. Constant blood studies were made and on discharge, all studies were found normal.
CASE IV. Septic abortion with pelvic abscess and peritonitis. Chemotherapy failure.*

M. L., a twenty-nine year old white female was admitted on October 16th with the following history: Her last menstrual period was on July 26th. Two weeks prior to admission she took twelve ergot pills followed by mustard baths. The following day she began to bleed vaginally passing foul smelling blood clots. Bleeding and passage of clots continued. Two days before admission she had chills, fever, malaise and weakness of arms and legs. The patient was a para III, gravida v. She had a seven-months fetus which died at birth. Her menstrual history, past history and system review were negative.

Physical examination on admission revealed an acutely ill patient. Her temperature was 100°F., pulse 112, respirations 24, blood pressure 112/76. The abdomen was soft with tenderness in both parametrial regions. Pelvic examination revealed the vagina to be filled with blood clots and placental tissue; the uterus was enlarged to the size of a three month's pregnancy; it was soft and boggy; the cervix was soft and admitted the tip of finger; the adnexa was tender bilaterally and a brawny mass was attached to the left side of the uterus. The patient had a swollen, tense and tender right olecranon and knee. A diagnosis of septic incomplete abortion was made. A D and c was done on October 18th and about 2 ounces of necrotic foul endometrium was obtained. The patient was put on sulfanilamide on admission. Following curettage the temperature became septic, striking between 101 and 104°F. Transfusions were given. The joint complaints had subsided by October 28th, but the temperature continued septic. Examination on October 31st revealed an extremely tender soft mass to the right of the uterus. On November 4th examination showed abscess of the right broad ligament. The patient was taken to surgery and a colpotomy done. About 35 ounce of frank pus and some cheesy material was discharged. A large tube was inserted for drainage. The temperature peak was 103°F.

On November 5th, 100 cc. of patient's blood was irradiated and reinjected. On the following day the temperature dropped to 101°F. and for the next few days it ranged between 99 to 100°F. On November 11th examination revealed a large tender mass in the left lower quadrant and the temperature rose to 101°F.; 150 cc. of patient's blood was again irradiated and reinjected. Her temperature began falling slightly but on November 13th a transfusion was given and the patient had a reaction with temperature rising to 105°F. Blood cultures were negative but on delayed growth was called Bacillus coli. The day following the transfusion reaction, the patient became jaundiced with an icteric index of 35. On November 17th the icterus began to subside and temperature became lower—between 99 to 102°F. On November 24th the colpotomy tube was removed, temperature began to flatten out and by November 27th it reached normal and remained so. However, examination on November 25th revealed the large tender mass in the left side extending almost to the level of umbilicus. By December 2nd the left adnexal mass had decreased some in size and tenderness.

Examination on December 12th revealed the right adnexal thickened, the uterus pulled to the right, normal in size, and a tender cystic mass in front and to the left of the uterus. The last examination made on December 16th revealed findings as above but the mass had decreased in size to three fingers above the symphysis on the left and a diagnosis of subsiding postabortal salpingitis was made. Catheterized urine examinations had been negative throughout. Hematological examination on admission showed 70 per cent hemoglobin and 23,000 white blood cells. Hemoglobin never fell below 60 per cent and a complete blood count on November 24th revealed 4.14 red blood cells with 72 per cent hemoglobin, totaling 2,950 cc. of citrated whole blood. Electrocardiograms were normal. Pelvic diathermy begun on November 30th was continued for ten days. The patient was discharged well. Follow-up clinic records show that the patient recovered from all intrapelvic disturbances, the uterus was free and moveable and there were no masses in the adnexae.

CASE V. Peritonitis due to nonhemolytic staphylococcus aureus. (Patient of Dr. E. D. 140 E. 54th Street, N. Y. C.) E. X. Chemotherapy failure.

E. M., was admitted on September 19, 1941 because of pain on defecation, metrorrhagia and tender pelvic mass. She had been operated upon in 1938 for ruptured appendix but had been in bad health ever since. Operative find-
ings were bilateral pyosalpinx with cystic degeneration of the right ovary, myoma uteri and chronic pelvic peritonitis. The patient did twelve days previously and when seen by me she was in an oxygen tent. Several films of the chest were examined and they disclosed the

well until the fourteenth postoperative day when she developed pain in the pelvis and started to run a temperature. Diagnosis of pelvic abscess was made and sulfathiazole was started, but discontinued the next day because of cyanosis. Ten days later a large abscess cavity containing 300 cc. of white nonodorous pus was evacuated from the region of an old appendix stump. Sulfathiazole was started again and the patient apparently tolerated it well this time. But on September 20th the temperature was still up to 105°F. and as there was a suspicion that this was due to the sulfathiazole a blood sulfa level was done which showed only a faint trace of the drug. The drug was discontinued but the temperature still continued. Two days later the patient was given a hemo-irradiation and in twenty-eight hours she was well, headache was gone, temperature was normal, appetite was excellent, she had no aches or pains and the draining sinuses healed and closed rapidly. The patient put on fifteen pounds in fourteen days, twenty-six pounds in twenty-one and thirty pounds in sixty days. She has remained in excellent health for the last one and one-half years.

CASE VI. Bronchopneumonia; chemotherapy failure.

I was called to treat a twenty-five year old female, a relative of a physician, suffering from bronchopneumonia. She had been taken ill characteristic shadows of bronchopneumonia. The patient in spite of oxygen therapy was moderately cyanotic. She was not responding to sulfa drug therapy and her white cell count was 9,000 in spite of a severe infection. Her physician and three consultants regarded the case as hopeless, and hemo-irradiation was requested as a last resort. The temperature ranged from 99 to 102°F. but had been higher. However, due to lack of resistance as indicated by the low white count and the patient's general condition, her temperature had remained relatively low (99–101°F.) for several days prior to my first visit.

The usual dosage was employed in this case, and I requested that the oxygen be cut down considerably following the irradiation, for we have found that even before an irradiation is completed, the color usually improves due to greater oxygen absorption. It is no uncommon experience to see the patient with cyanosis become pink before the irradiation is completed. The following day this patient was receiving no oxygen. She was much stronger, and was sitting up. She convalesced satisfactorily, having received only one hemo-irradiation.

CASE VII. Infectious arthritis with severe toxemia; chemotherapy failure.

A. K., a male chief tool and die maker for a naval ordnance plant, became ill about No-
November 30, 1941, with severe pains and swelling in his left wrist. He was removed to a hospital where eighteen teeth were extracted. In spite of this, his wrist became more swollen and painful. He remained in the hospital for fourteen days during which time he lost sixteen pounds. His physician requested hemo-irradiation as he was gradually getting worse, and when treated by me on December 17th he was very toxic, his hand greatly swollen, was in a sling and he could bear no one to touch it. His sedimentation rate was 120 mm. in sixty minutes. Within an hour after the irradiation he could move his fingers and permit examination of the hand and wrist. The following day his appetite returned, he was obviously much less toxic and much stronger. He had a second irradiation on the 19th at which time his sedimentation rate had fallen to 60 mm. He returned to work on December 22nd, having gained seven pounds in six days, and has been well since.

Case VIII. Thrombosis of the superior inferior cerebellar artery, bronchopneumonia, pyemia, embolization of the lungs, left femoral thrombophlebitis, paralysis of the left side of body and left vocal cord.21

In January, 1940, the author was called to Miami to treat the brother-in-law of a New York physician for a severe toxemia. He had become ill with severe pains in his right shoulder accompanied by intermittent elevation of temperature. He was admitted to a local hospital where in a day or so a swelling appeared in the clavicular region, and soon extended to the right side of the neck. He developed pyemia with embolization of the lungs and bronchopneumonia. Flaccid paralysis of the left side of the face and paralysis of the left vocal cord developed. He coughed with great productivity, there was choking and food was vomited. He became delirious and irrational. When seen by me he had taken nothing but coca cola for eleven days. He had lost forty-five pounds in weight and was in an oxygen tent. His brother-in-law had employed autohemic therapy some days previously without response. I had the man transferred to the Miami Beach Hospital where hemo-irradiation was instituted. There was an immediate response to the first treatment, and a second was given in three days with more improvement. Returning to New York, I was called a second time to Miami, for there had been a slight elevation of temperature. Four days after this the patient was brought to New York and admitted to the Manhattan Eye, Ear and Throat Hospital and placed under the care of Dr. A. Cinelli. He remained there six weeks, when his improvement justified his removal to his home, where in the course of several months he made a complete recovery, and when last seen in December, 1941, he had gained back his lost forty-five pounds and had added ten more. He showed no sign of his serious illness.

The case is not presented in full for lack of space, but it is reported to draw attention to the practically hopeless condition of a patient suffering from what was discovered in New York to be a thrombosis of the superior inferior cerebellar artery with a number of severe complications. The hemo-irradiation was given in the hope of controlling the marked toxemia—he had on a number of occasions a sediment rate of 120—and also to build up his resistance. During the hospitalization in New York, he developed a thrombosis of the femoral vein on the left side accompanied by rise of temperature and very severe pain. Various measures were used without avail, but after an irradiation there was a prompt response and this complication disappeared in two or three days. In all, this patient was given nine hemo-irradiations, three in Miami, three at the Manhattan Eye, Ear and Throat Hospital, and three after he returned home. During his convalescence at home, it was discovered that he had a toxic goiter which accounted for the continued elevation of the pulse rate. This condition was treated by radium with very satisfactory results.

Case IX. Staphylococcus pyogenes aureus blood stream infection and foot-drop following the administration of sulfamethathiazol. Chemotherapy failure.

A white unmarried woman, aged twenty-eight, had a chill followed by fever on May 11, 1940. No cause was discovered but as her fever continued she was admitted by her physician, Dr. Carl Zoll, to Wickersham Hospital, New York, on May 14th. At this time she was acutely ill and did not complain of headache or pain of any kind, only a feeling of malaise. Her temperature on admission was 102.6°F. Two days later a blood culture was reported positive for Staphylococcus aureus. She was placed on neo-prontosil and under this her temperature gradually fell. For reasons not disclosed by her hospital chart, she was dis-
charged from the hospital June 10th. Her temperature was about normal, but she had a positive culture the day of discharge and she also had a secondary anemia of moderate degree.

Two days later she was re-admitted with a temperature of 100.6°F. and the same day was given a 500 cc. blood transfusion, and prontosil was continued. Her temperature fluctuated between 97 and 99°F. and she had a number of negative cultures, but also three positives. On July 12th, it was decided to discontinue the neo-prontosil and try sulfamethathiazol, but the positive cultures continued and in a few days she developed foot-drop.

As the patient was making no real progress, the sulfa drugs having failed to clear up the blood stream infection and also because of the foot-drop, sulfamethathiazol was discontinued and Dr. Zoll requested me to give his patient an irradiation of her blood by means of the Knott technic. The amount of blood treated was 210 cc. Six days later a blood culture was returned positive. Meanwhile thiamin chloride was instituted for the foot-drop. A second hemo-irradiation was given eleven days later together with a blood transfusion of 300 cc. This was her third blood transfusion and her second hemo-irradiation. It is only fair to point out that the 3rd blood transfusion given with the second hemo-irradiation may have played a role in clearing up the secondary anemia, although the two previous blood transfusions had not been followed by any improvement.

Three hemo-irradiations were given after the patient left the hospital to prevent any possibility of relapse. The only medication received after the first hemo-irradiation was thiamin chloride for the foot-drop. This condition cleared up very rapidly under this therapy.

Long before the Knott technic of hemo-irradiation was introduced, ultraviolet spectral energy had proved to be a therapeutic agent of preeminence in a variety of conditions: rickets, infantile tetany, extra-pulmonary tuberculosis, erysipelas, lupus vulgaris, various skin conditions, certain diseases of the eye (Duke-Elder), et cetera.

By the Knott technic the scope of therapeutic usefulness of ultraviolet radiation has been considerably increased so as now to include bacteremias, toxemias, peritonitis, thrombophlebitis and other serious infective conditions in which the operator can now anticipate prompt and effective action even when sulfa drug therapy and ordinary transfusions fail.

It is a method which raises the general resistance of the individual, diminishes toxemia rapidly and stimulates the healing forces of the body.

It is a safe method with no untoward reactions. It can be used to supplement other recognized measures, operative and medical, but in its own right it is a measure which will often effect a cure when all other therapy has failed.

Nine illustrative cases are offered as evidence of the unusual therapeutic properties of this new method of employing ultraviolet radiant energy with precision apparatus which overcomes most of the uncontrollable factors which have hitherto made the administration of this energy uncertain even in the hands of skilled operators; and it makes possible the treatment of serious infections heretofore not amenable to conventional ultraviolet radiation therapy.

SUMMARY

The author in a five-year period (February 16, 1938 to February 16, 1943) has treated over 400 patients suffering from a variety of conditions, infections of various kinds, systemic and regional, including the eye. He has used the method in about thirty cases of asthma and in about sixty cases of arthritis, rheumatoid, infectious and osteoarthritis. In all about thirty-five different conditions have been treated.

REFERENCES

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