

## Chapter XIV

### USE OF SERUM AND X-RAYS IN GAS BACILLUS INFECTION

#### TREATMENT

In our early reports we stated that whether or not serum should be used with x-rays is a less important question than is the problem of amputation and débridement. Before any statistics were available, the use of extensive surgical measures, especially amputation, seemed unnecessary. The fact that x-rays had repeatedly been effective after prophylactic and therapeutic serum had not checked progress of the disease was also impressive, and in the conclusions of the first report it was suggested that less serum be used because it often caused annoying serum reactions.

Not long after the first report Faust<sup>28</sup> sent us data on a case he treated without serum with excellent results. Owens<sup>29</sup> reported to us several cases treated successfully without serum which we included in the early series of cases. In our cases,

TABLE 15

CASES	SERUM	NO SERUM	DEAD	MORTALITY, %
123	105		9	8.5 with serum
		18	1	5.5 without serum

good results were obtained with serum; but the few patients who were unable to buy serum were treated successfully without it; *no* deaths occurred in any of our cases treated without serum. Later, as the cases accumulated, the figures shown in Table 15 were available and were presented in the report made before the International Congress of Radiology.<sup>11</sup> As stated in that report, the figures in Table 15 were not important except as evidence that a patient can get well without serum. The mortality figures for those who received serum and those who did not showed no essential difference (3 per cent) at that time, and they are still remarkably similar (2.4 per cent) despite the increased number of cases.

Table 16 includes the most recent statistics. In all cases, gas

bacillus infection was present and x-ray therapy was given. In the diabetic and arteriosclerotic groups, many of the patients were operated on; a few were not. The data show no substantial advantage to be obtained through the use of serum in treating gas bacillus infection when x-ray treatments are given.

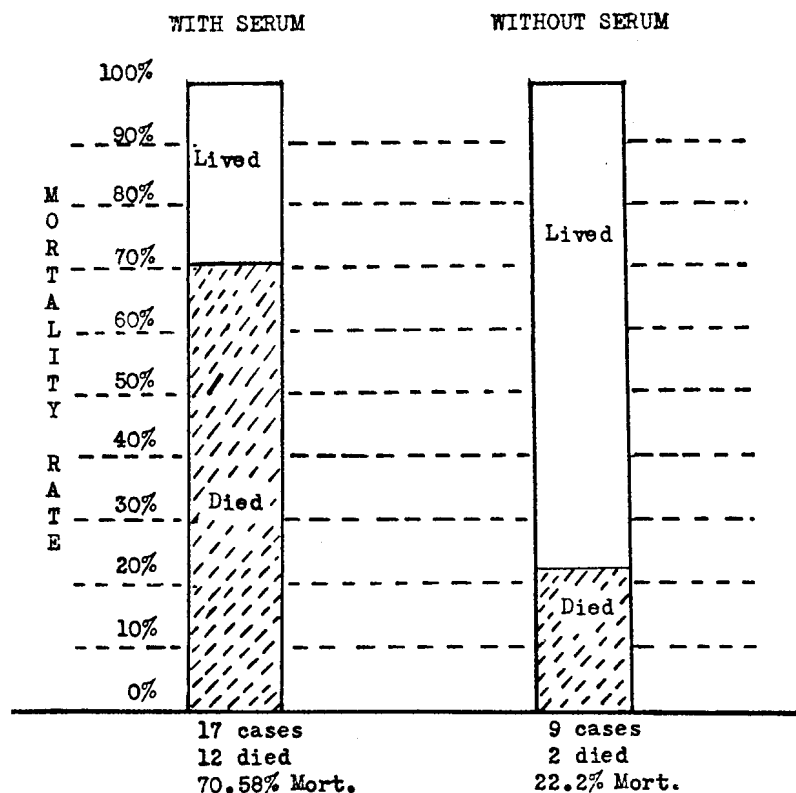


FIG. 25.—Mortality in diabetic patients who developed gas bacillus infection and received x-ray therapy. The data indicate that such patients probably do better without than with serum when treated with x-rays.

Whether or not there is any significance in the greatly lowered mortality rate for the diabetics who had no serum over that for those who had serum (Fig. 25) can only be determined after more data have been obtained. From the figures presented, one might suspect that the diabetic is not as well able to support the added toxemia induced by the serum as is the normal individual. At any rate, one should not worry if serum is not available for

use in treating the diabetic patient in whom a gas bacillus infection develops as a result of peripheral circulatory breakdown or surgical intervention for it. Perhaps one should use no serum in this group, as the mortality rate is definitely lower without it.

TABLE 16  
RESULTS OF X-RAY THERAPY OF GAS BACILLUS INFECTION WITHOUT AND WITH SERUM THERAPY

	WITHOUT SERUM			WITH SERUM		
	Cases	Deaths	Mort.	Cases	Deaths	Mort.
Post-traumatic.....	65	7	10.76%	263	32	12.16%
Diabetic.....	9	2	22.2%	17	12	70.58%
Arteriosclerotic.....	4	4	100.0%	9	6	66.6%
Combined totals.....	78	13	16.66%	289	50	17.30%

The lowest mortality in any series of reasonable size is the group of 42 cases of post-traumatic gas bacillus infection in which three or more x-ray treatments were given but no serum and no amputations, with only two deaths, a mortality of 4.7 per cent. The results in this series without major surgery or any serum support strongly our contention that x-ray is the most important therapeutic agent at our disposal at this time in treating gas bacillus infection and that x-ray therapy alone is adequate in most cases.

TABLE 17  
STATUS OF SERUM IN POST-TRAUMATIC GAS BACILLUS INFECTIONS, WITH REFERENCE TO NUMBER OF TREATMENTS GIVEN

NO. OF X-RAY TREATMENTS	WITH SERUM			WITHOUT SERUM		
	Cases	Died	Mort.	Cases	Died	Mort.
1.....	19	11	57.89%	8	2	25%
2.....	22	5	22.72%	11	3	27.27%
3 or more.....	207	15	7.24%	46*	2	4.34%

\* This includes four patients who had amputation and recovered, giving a total of 42 patients who received no serum or amputation, of whom two died (4.7 per cent).

The lowest mortality rate so far reported for any series of gas bacillus infection is 4.7 per cent (Table 17). This result was

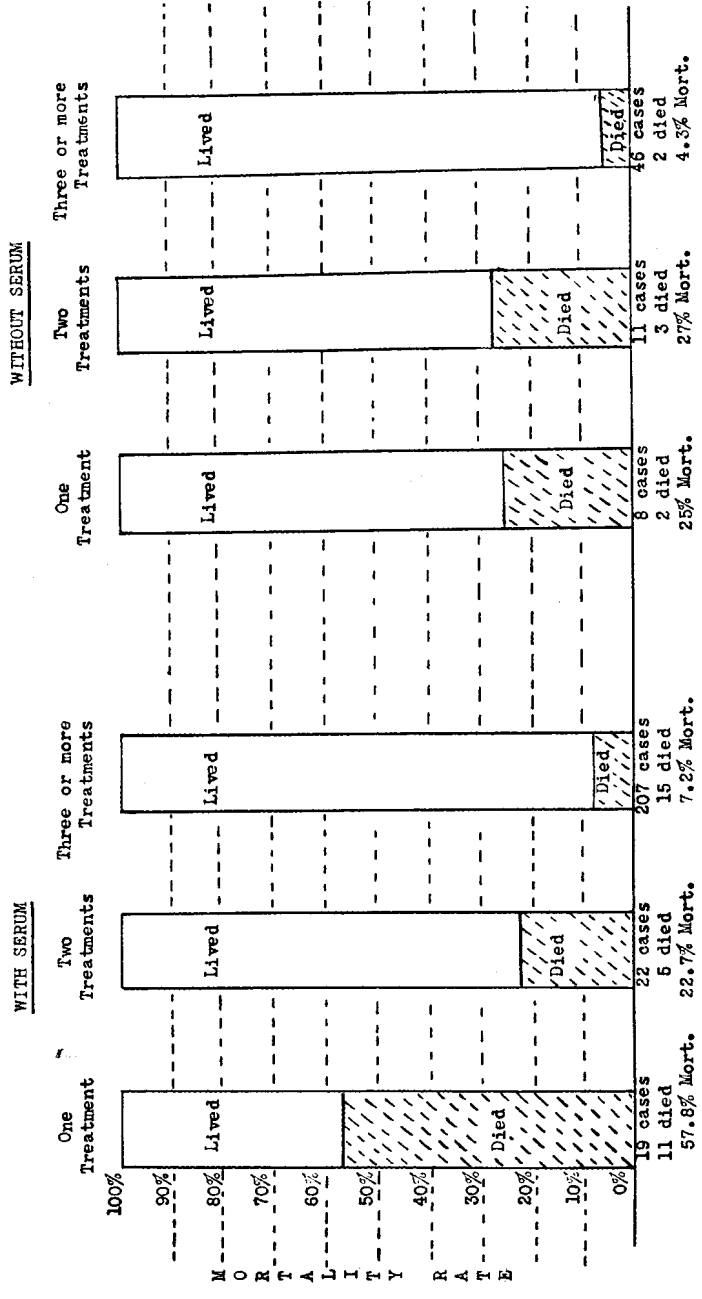


FIG. 26.—Mortality rate of post-traumatic gas bacillus infection according to the number of x-ray treatments with and without serum.

obtained without the aid of any of the old methods such as serum and amputation, but with x-ray therapy alone.

The advantage of giving frequent small doses of x-rays is apparent. The plea for treating early in the disease is supported by the figures shown in Table 17, since they show a mortality rate of 57.89 per cent for the 19 patients in the group

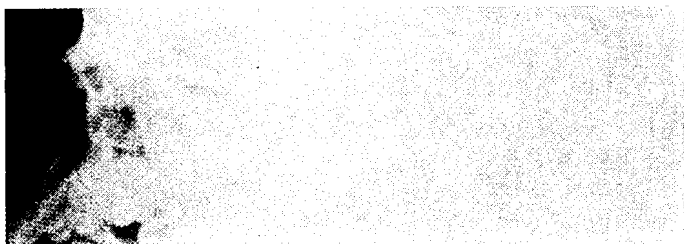




FIG. 27.—Case 12. Fracture of mandible with some gas in swollen soft tissues of cervical region. Recovery by x-ray therapy alone.

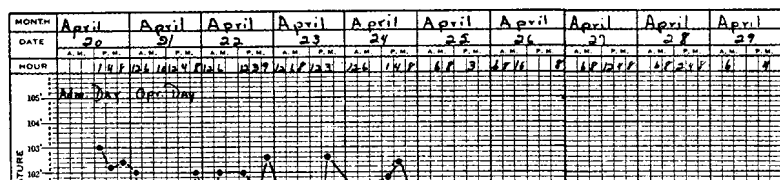
receiving one x-ray treatment and serum, as contrasted with 4.34 per cent for the 46 patients receiving three or more treatments without serum—a difference of great significance in any clinical evaluation (Fig. 26).

*It seems, therefore, that x-rays alone offer the ideal and most effective means of treatment. Serum is nonessential; amputation*

*and débridement during the acute phase are detrimental. Sulfanilamide and its early derivatives are also highly detrimental.*

Gas Bacillus Infection with Recovery

CASE 12.—H. B., a Negress aged 27, entered the County Hospital, Apr. 20, 1938, with a history of having been struck on the jaw three days previously. The day after the injury the jaw was painful and markedly swollen, but the patient was not especially ill. On the



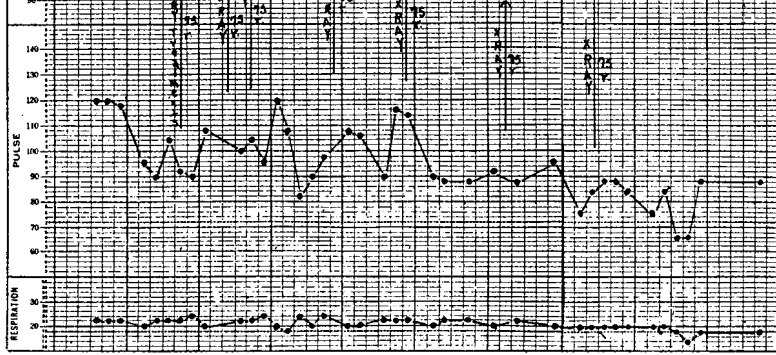


FIG. 28.—Same case as preceding. Irregular, somewhat persistent temperature can be expected when the disease is well established before treatment is started. The rise in temperature might have been prevented if two treatments instead of one had been given on the third day. Technical factors were: 100 kv.; 5 ma.; 40 cm. distance; 2 mm. Al filter; left sides of face and neck as port. Result was good.

second day the pain increased and the jaw and the side of the neck became markedly swollen and puffy. The patient had a severe headache, nausea and vomiting and five chills during the day, each of which lasted 15 to 20 minutes. The third day after the injury the patient was taken to the Creighton Dispensary and from there was immediately sent to the County Hospital. On admission, an x-ray film showed a fracture of the mandible with a large amount of gas in the soft tissues (Fig. 27). The white blood cell count on admission was 18,000, with 61 per cent polymorphonuclears. The Wassermann reaction was

negative. An incision was made and drainage established by Dr. Yechout on April 21. The patient received seven x-ray treatments and recovered rapidly (Fig. 28).

In this case, recovery was prompt when one considers the extent and character of the disease. The patient received no sulfanilamide or serum. The case indicates that débridement, serum and sulfanilamide are unnecessary.

#### SERUM AND X-RAYS IN PREVENTION OF GAS BACILLUS INFECTION

Any consideration of the treatment of gas bacillus infection is not complete without a discussion of the use of serum and

*Anti-Gas Serum.*—The value of serum in prophylaxis, as in therapy, is scoffed at by some and approved by others. There is ample proof in the literature and observation in our cases to show that serum often fails to prevent the disease. Despite this, there is no proof that serum has not succeeded in preventing the disease in many other cases in which it was used. The question of its value, as it pertains to man, cannot be answered definitely.

The critics of the use of serum have as a basis for their criticism the cases in which gas bacillus infection develops despite its prophylactic administration. Advocates of the use of serum cite the large number of cases in which serum was given after an injury and gas bacillus infection did not develop. Neither side has any convincing claim on which to base its contention.

At best, the relative effectiveness of serum can only be determined by statistics, since it is evident that one cannot claim complete success. Since statistics concerning human beings during the last few years seem to indicate that therapeutic serum aids the surgeon in lowering his mortality, the claim that it is of value in prophylaxis seems reasonable, but it cannot be proved at this time (Table 18).

*Comparison of Effects of Serum and X-rays.*—In experimental work on animals, serum has been highly effective, but the same consistent results have not been secured in man. The opposite is true of the use of x-rays; it has been highly effective in man

TABLE 18

CASES REPORTED IN DETAIL IN THE LITERATURE IN WHICH PROPHYLACTIC SERUM WAS GIVEN AND GAS BACILLUS INFECTION DEVELOPED\*

AUTHOR	CASE NO. IN OUR SERIES†	CASE NO. IN REPORT	ONSET OF DISEASE
Kelly, J. F. (Radiology 31:608, Nov., 1938) .	66	MS	2d day
Faust, J. J. (Radiology 22:105, Jan., 1934) . .	32	1	3d day
(Illinois M. J. 66:547, Dec., 1934) . . . . .	38	7	2d day
(Texas State J. Med. 34:404, Oct., 1938) .	40	5	5th day
Kelly, J. F. (Radiology 31:609, Nov., 1938) .	20	GEL	2d day
Hanchett, M. (West. J. Surg. 43:199, April, 1935) . . . . .	16	11	2d day
(Ibid.) . . . . .	23	12	2d day

(Ibid.).....	92	2	
Anderson, R., and Wirth, J. E. (Staff J. Swed. Hosp. (Seattle) 1:70 Oct., 1937) .....	314	2	2d day
Anderson, R. (Surg., Gynec. & Obst. 64:919, May, 1937).....	313	1	2d day
Gambill, I. M., and Cupp, H. B. (M. Bull. Vet. Admin. 14:286, Jan., 1938) ...	161	1	3d day
Buchanan, J. C. (Recorder, Columbia M. Soc., Richland Co., S. C., 3:9, March, 1939).....	149	1	4th day
McNamee, E. P., and Lulenski, C. R. (Ohio State M. J. 35:1062, Oct., 1939) ...	100	1	2d day
(Ibid.).....	150	2	2d day
(Ibid.).....	305	3	2d day
(Ibid.).....	308	6	2d day
(Ibid.).....	311	9	2d day
Bowen, A. (Mil. Surgeon 86:107, Feb., 1940).....	222	1	2d day
(Ibid.).....	223	2	2d day
Total.....	20		

\* These data relate only to cases which received x-ray therapy. All patients recovered.  
† Every case we have analyzed has a number in our file for reference.

but has been ineffective in experimental animals. It is probable that serum is so effective in animals because the bacteriologist and serologist can produce an effective serum when they know the specific organism with which they are dealing. Unfortunately, the same situation does not exist in clinical work. For man,

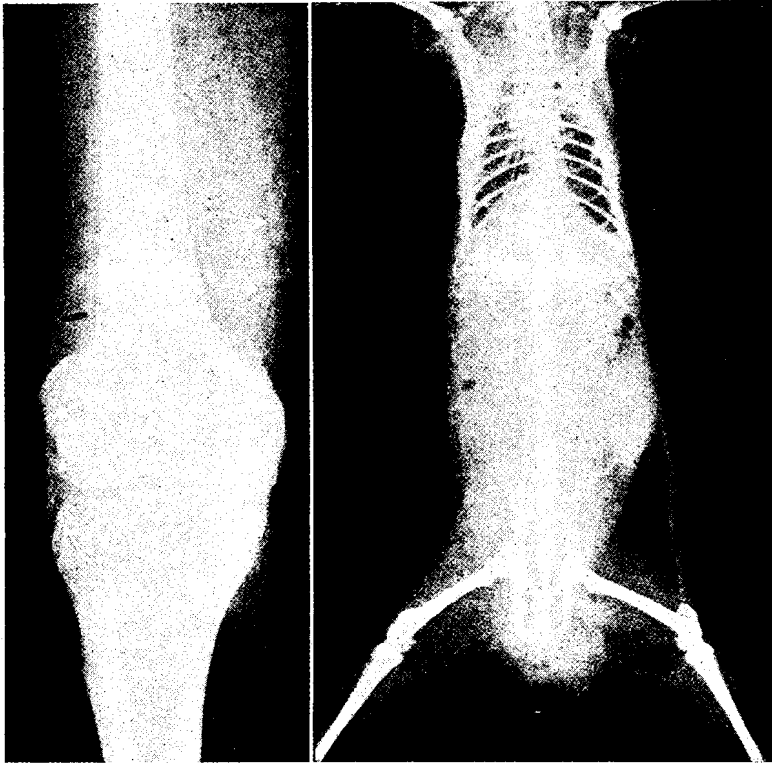


FIG. 29 (left).—Case 13. Gas in the soft tissues of knee area. Arrows point to pockets of gas in soft tissues.

FIG. 30 (right).—Film of guinea-pig infected with organisms cultured from the wound of patient in Case 13. Accumulation of gas in thigh and lower abdominal area. The pigs infected with this organism could not be cured by x-ray therapy, but the same organism that failed to respond to x-ray therapy in the guinea-pig responded promptly in this patient.

the serologist attempts to supply serum containing sufficient units of antitoxin for the numerous possible organisms involved. The task is difficult in such a mixed infection as is generally seen in gas bacillus infection.

In this respect again x-rays differ from the highly selective

serums, for so far as we know x-rays seem to be effective against all the pathogenic gas-forming organisms—a nonspecific effect of practical importance. One requires no laboratory identification of the involved organisms before starting x-ray therapy.

CASE 13.—M. S., a man aged 23, received a severely lacerated wound in the knee area. He was admitted to the hospital immediately and received prophylactic gas and tetanus serum. The following day gas bacillus infection was evident. He received two x-ray treatments a day for three days and responded promptly. Despite the severe laceration, no amputation was done. A skin graft was finally necessary.

This patient received prophylactic serum and, like hundreds of others who have been given serum for prophylaxis, developed the disease. Figure 29 shows gas in the tissues. Figure 31 shows the extent of the injury. Organisms cultured from the wound



FIG. 31.—Wound of patient in Case 13; prompt healing after x-ray therapy. A skin graft was necessary to improve functional capacity of the knee.

were used to infect a guinea-pig; Figure 30 shows gas in the soft tissues of the left thigh and left sacral region. The animal died, of gas bacillus infection despite x-ray therapy, but the patient recovered promptly.

Animal experimental work with gas organisms has never given as satisfactory results as those obtained clinically. The guinea-pig may be hypersensitive to the infection or some other factor may enter into the problem ("all or none" law). Those who refuse to treat their patients because animal experimental work is not successful make a serious mistake. In Case 13 the same

organism that killed the guinea-pig responded well to x-ray therapy in a human being.

Recently, successful experimentation using dogs infected with washed cultures of gas-forming organisms was completed by Dowdy and Sewell<sup>34</sup> at the University of Rochester Medical School. This work should satisfy those who have insisted on some successful animal experimentation before they felt justified in using x-rays for man.

