

Staff Meeting Bulletin
Hospitals of the » » »
University of Minnesota

Radiation Therapy

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Published for the General Staff Meeting each week
during the school year, October to May, inclusive.

Financed by the Citizens Aid Society

William A. O'Brien, M.D.

I. LAST WEEK

Date: April 18, 1941
Place: Recreation Room
 Powell Hall
Time: 12:15 to 1:15 p.m.
Program: Movie: "Good Scouts"
 Athletic Injuries
 George W. Hauser
 Edward T. Evans
 Lloyd Stein

Present: 122
 Gertrude Gunn
 Record Librarian
 - - -

II. MOVIE

Title: "Quicker'n a Wink"
 A Walt Disney Mickey Mouse
 Released by: R-K-O
 - - -

III. ANNOUNCEMENTS

1. MINNESOTA STATE MEDICAL ASSOCIATION's Eighty-eighth Annual Meeting will be held in the St. Paul Auditorium, May 26, 27, and 28. Railway surgeons of the Great Northern and Northern Pacific Railways will meet jointly with the Association. Tuesday, May 27, the entire day's program will be devoted to the subject of "Trauma." Monday noon there will be a reunion luncheon meeting. On Tuesday and Wednesday noons, there will be ten round table luncheons daily devoted to special subjects. The guest speakers include Thomas M. Joyce, clinical professor of surgery at the University of Oregon Medical School; Sumner Koch, associate professor of surgery, Northwestern University Medical School; Leroy Sante, professor of radiology, St. Louis University School of Medicine; Edward D. Churchill, John Homan professor of surgery, Harvard Medical School; Albert D. Kaiser, associate professor of pediatrics, University of Rochester School of Medicine and

Dentistry; Walter M. Simpson, clinical pathologist, Dayton, Ohio, and H. H. Kessler, orthopedic surgeon, Newark, New Jersey.

Col. John R. Hall, Washington, D. C. will take part in the military program May 28 at which time physical findings among selectees, the nutritional problem of the national defense, and the part to be played by the medical profession in the general military program will be discussed. Mr. C. M. Utley, national president of the Foreign Policy Association, will speak for the Alumni Association of the University of Minnesota. There will be a large scientific and commercial exhibit in the auditorium, and on Monday evening, May 26, there will be open house and entertainment. The theme will be "The Gay Nineties." The golf tournament is scheduled for Sunday, May 25, at the White Bear Yacht Club. Members of the University of Minnesota Medical School Staff are invited to attend.

2. CENTER FOR CONTINUATION STUDY

A study course in Roentgen Diagnosis of Non-tuberculous Diseases of the Lungs and Pleura will be offered at the Center for Continuation Study, May 22, 23, and 24, 1941. Enrolment limited to physicians with special training in radiology. Subjects: non-tuberculous inflammatory diseases, atelectasis, emphysema, bronchial asthma, congestion and edema, tumors, cystic disease, and various diseases of the pleura.

Tuition \$15, room \$1.25-\$1.75 per day, meals \$1.50 per day (room and board optional), garage space in building. A check for \$3.00 will cover registration now. Program details later.

Address: Center for Continuation Study, University of Minnesota, Minneapolis.

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IV. RADIATION THERAPY FOR INFLAMMATIONS

Dan. L. Fink

Although roentgen therapy has long been known to be a useful expedient in the treatment of many inflammatory conditions, it has never attained widespread use. It is true that often such therapy is not available. Even when available, the cost often makes radiation therapy inadvisable. Perhaps one of the objections most frequently made by physicians against the use of x-rays for the treatment of benign conditions is the reaction to the treatment. In this regard it should be emphasized that when properly administered, roentgen therapy for an infection is attended by no objectionable nor prolonged reactions since the dosage used falls far short of producing even an erythema of the skin. On the other hand, infections often respond to x-ray therapy to the point of complete resolution, thus obviating surgical intervention. The presence of an unsightly scar on an exposed area may thereby frequently be prevented.

In the case of the more malignant infections, such as surgical parotitis and gas bacillus infections, the prognosis may be materially altered by making use of roentgen rays, as will be pointed out later in this discussion.

Desjardins^{11,13} attributes the lack of enthusiasm to the use of roentgen therapy in infections to four factors, namely: 1) Skepticism on the part of the profession as to the curative value of x-rays because of claims of its efficacy in a multiplicity of infectious states, 2) Disbelief because of the varied explanations for the mode of action, 3) Fear of permanent damage, and 4) Lack of knowledge of its effect. However, there are about 300 papers published on the use of x-rays in the treatment of infections and for the most part these investigators were favorably impressed with the results obtained.

Soon after the discovery of the x-rays by Roentgen in 1896, it was found that these rays exerted an effect on tissues. As early as 1897, reference to the effects

on inflammatory conditions of the skin was made.¹⁴ In 1902, it was reported that in the course of the roentgen examinations skin infections were noticed to improve. This was of course quite plausible in those early days of roentgenography when long exposure times were necessary. Later, when more was known of the action and dosage of roentgen rays, it was learned that doses much smaller than had theretofore been used were adequate to control inflammatory processes. Gradually more and more inflammatory conditions were treated by this method until today, one can find references to the use of roentgen therapy in the treatment of practically every type of inflammatory lesion. Our own files show some 25-30 types of inflammation for which x-rays have been employed.

Since the action is similar in various types of infections, a factor common to these infections must be sought for to obtain an explanation. It has been shown by several investigators that roentgen rays in doses comparable to those used to treat inflammatory lesions, are not bactericidal. Likewise, x-radiation does not act on bacteriophage.⁴⁰ However, pyogenic infections are characterized by leucocytic infiltration and it has been clearly demonstrated that lymphocytes are rapidly injured or destroyed by roentgen rays. It is therefore conceivable that upon the destruction of the lymphocyte, antibodies or protective substances are liberated directly in contact with the organism. This explanation is held by many roentgenologists,^{2,12,24,47,68} and although partially theoretical, offers a clear and acceptable picture of the process.

Stenstrom and King^{42,68} have shown that small doses of x-radiation will inhibit growth of lymphocytes in tissue culture. The work of Wooley and Butler on sinusitis in cats showed a decrease in lymphocytes in the infected area when treated with x-rays. Haidenhain and Fried^{23,28} likewise demonstrated leucocytic changes in inflammations when treated with x-rays.

Shaeffer⁶⁴ infected rabbits with a virulent strain of staphylococcus aureus

by injecting the organism into the subcutaneous tissues. In a controlled experiment he showed that although he was unable to cause resolution of the process by irradiation, suppuration occurred more rapidly and the course was materially shortened. He likewise demonstrated that an early increase in cellular elements, especially in the deeper tissues, takes place and that more cells appear about the infected area when treated with x-rays. He also demonstrated changes in the connective tissue fibers which he thought made healing more rapid. He concluded that x-rays acted by causing the cells to break down and liberate antibodies which killed the organism and by increasing the activity of the connective tissue cells thereby hastening healing.

It must be pointed out, however, that this leucocytic change has not been universally substantiated. The work of Motojima⁵⁰ may be taken as example. In a controlled study on rabbits he found that with 1 erythema dose (human) the treated area was smaller and showed constant vasodilation and perivascular accumulation of leucocytes. There was also more rapid healing than on the untreated side. Doses suggested for treatment in humans produced no change. In this regard it must be emphasized that the rabbit is less sensitive to radiation than the human and this difference in effect may well be explained on a species difference. Motojima failed to detect any morphological changes in the leucocytes in the treated area as compared to the untreated area.

Maximow some 5 years earlier, likewise failed to detect any effect on the leucocytes in irradiated tissue, but did note some change in the connective tissue cells.⁴⁸ He found that the action of x-rays on inflamed tissues manifests itself by a depression of the usual reaction on the part of the fibroblasts and a loss of their capacity for collagen formation; by edema which was constant; and by an increase in duration and rate of cells coming from the blood. His failure to note changes in the leucocytes may be explained by the fact that his studies were not done during the first 3 days after irradiation.

The action of roentgen rays may produce an effect on the normal immunological responses of the body and in this respect it has been demonstrated that small doses enhance the bactericidal properties of the blood. This effect is transient and if larger doses are used, the opposite effect is obtained.²⁹

Soto and his co-workers⁶⁷ found no evidence of leucocytic destruction and the exudate on the treated area was identical to that in the area untreated. Their evidence showed the effect of irradiation to be on the capillary bed causing more rapid absorption of soluble substances from the inflamed area. However, as Desjardins has pointed out, these men did not use doses similar to that usually employed in treating infections in humans, and furthermore, the radiation was more penetrating.

Recently, Pendergrast and Hodes⁵² have also suggested that the effect of radiation in the treatment of inflammations is chiefly on the vascular system. They point out that the most constant observation in studies of inflammations treated with radiation is vasodilation. This vasodilation occurs not only in the inflamed area itself, but in the adjacent tissues and thereby produces an "active hyperemia." As a result, there is an increase in the local temperature, more electrolytes are brought to the infected area and there is less edema. They further believe, that when treated early the inflammation may be resolved since its products are rapidly carried away by virtue of the hyperemia; but late, when the area has been "blockaged by vascular thrombi" (Menken) resolution cannot be obtained. It must be pointed out, however, that these investigators fail to hit a fundamental basis for their explanation, since they do not explain how the radiation produces the vasodilation.

There can be little doubt that the mechanism of action of roentgen rays in treating infections, whatever it is, is a complicated one. It is probably not due to a single factor, but hyperemia, blood cells, immunity and resistance---all, likely play a part.

In the clinical investigation of roentgen therapy of inflammatory conditions, it must be born in mind that the evaluation of the results is very difficult, since the conditions we are treating are those from which most of the patients recover. Thus by necessity, most clinical reports on this subject are records of the investigator's impression of the effectiveness of the treatment, rather than a statistical analysis of controlled studies.¹⁷

This same difficulty has confronted us in reviewing the experiences of this department in roentgen therapy for inflammatory conditions. Nevertheless, we are able to obtain certain impressions from this analysis which we present here. Table I represents a list of inflammatory conditions which have been treated at the University Hospitals with x-rays from 1926 to 1941. Tuberculosis, fungus and virus infections have not been included in this study. Neither have infections of the anterior chamber of the eye been reviewed here.

Table I

Inflammatory conditions treated
with x-radiation at University
Hospitals (1926-1941)

	<u>Cases</u>
Acute Cervical Adenitis	8
Bone & Joint Inflammations	6
Carbuncles and Furuncles	65
Hydroadenitis	27
Paronychia	13
Gas Bacillus Infection	8
Mastitis	6
Parotitis	47
Pelvic Inflammatory Disease	4
Peritendinitis	50
Pulmonary Inflammations	
Bronchiectasis	24
Pneumonia	4
Lung Abscess	2
Sinusitis	16
Tonsillitis and Pharyngitis	<u>45</u>
TOTAL CASES REVIEWED	278

Adenitis - Our experience in the treatment of adenitis has been limited to 8 cases. All had cervical involvement. Four of these, treated early, responded well and did not require incision. One case was treated after incision and healed nicely. The remaining three cases were treated late in the course. The treatment seemed to hasten suppuration in these cases.

From the reports of other investigators^{11,28,32} it would appear that roentgen therapy, administered early in the disease, exerts an extremely favorable effect on acute cervical adenitis. Since our cases have been so few, we are unable to draw any conclusions from them. However, this condition is so common, especially in children, and so frequently progresses to suppuration requiring surgical drainage that it might be well to try radiation therapy early. In any event, no harm will be done with the small doses used, as the conventional methods of conservative therapy could be carried out simultaneously.

Inflammations of Bones and Joints

Although our series is too small to be significant, our experience coincides with other investigators^{28,70} who have found that x-radiation offers little in the treatment of such inflammatory conditions. Some of these patients experienced some relief of pain but in no instance was there any great change in the patient's general status.

Included in this group are 6 cases, 2 chronic osteomyelitis, and one each of aseptic necrosis, Garre's disease, synovitis and osteitis.

Carbuncles and Furuncles

In general, investigators studying the action of radiation on this group of conditions have been very enthusiastic. Pain is rapidly relieved, the course of the disease is shortened with less scarring and rapid relief of lymphangitis.³² As early as 1916, Dunham stated, after observing 67 cases of carbuncles treated with x-rays, that "nothing in x-ray therapy gives such positive and uniformly perfect results as the treatment of carbuncles."¹⁶ Baensh found in compar-

ing 103 cases of furuncles of face and neck treated with x-ray to 103 cases handled by surgical means (conservatively) that the former group had a mortality of 1.9% whereas in the latter group 10.7% died.⁴ He noted that x-rays exerted a remarkable effect on relief of pain and that smaller doses were effective the earlier the lesion. On the other hand, Newell recently stated that he was studying a group of cases all handled alike except that alternating cases were given x-rays with no attempt at selection of cases. It was his impression that the 2 groups were very similar in their end results.

Our impression is that x-radiation exerts a favorable influence on the course of such infections.

We have treated 65 cases. It is interesting to note that 38% of these cases were in members of the hospital staff. It has been impossible to get follow-up information concerning many of these patients. Of the 30 patients about whom we were able to get information, 25 were definitely and quickly relieved; 5 showed only slight improvement. Of these 5 patients one had leukemia, one had chronic glomerulonephritis with severe uromia, and one had leucopenia of a marked degree.

We believe that this type of lesion when treated early will in most instances completely resolve provided of course there is no general underlying condition to enhance its continuance. The lesions treated late will, in our opinion, undergo healing more rapidly. In all cases pain will be greatly relieved. We do not propose that other methods of treatment be disregarded since when suppuration does occur, incision is definitely indicated. Likewise, the application of heat seems to enhance the action of the x-rays.⁵⁰

The technique generally employed for early lesions is 100 kv, 7 MA, 20 to 30 cm distance, with 0 to 1 mm Al filter given 100 to 200 r and repeating 2 to 3 times. When the lesions are of longer duration we may give 200 to 400 r and repeat once. Occasionally we treat deep seated lesions with higher voltage-- 140 to 200 kv with 2 mm Al and $\frac{1}{4}$ mm Cu

filter.

We would like to include in this discussion of carbuncles and furuncles a group of 27 cases of hydroadenitis because many of these cases coming to us with such a diagnosis we feel have actually been cases of axillary furunculosis and vice versa. In contrast to the report of Pendergrast and Hodes,⁵² our results with this inflammatory condition have been quite gratifying. Based on information in follow-up of these patients it can be said that the acute cases in general have responded promptly, the large majority without incision. In a few suppuration was hastened and after incision they healed promptly. In contrast, those of long standing (one had been present for 11 years) responded poorly if at all. This agrees with Fried's work.²³ He found 96.5% of cases responded favorably to irradiation.

Our method has been to deliver moderate repeated doses to the involved area. 100 kv peak was used with 7 ma; 30 cm dist, 0 to $\frac{1}{4}$ mm Cu filter given 150 to 200 r repeated 2 to 3 times. This same technique has been employed for all cases, acute or chronic.

In reviewing these cases we feel that in the future it may be well to handle the chronic cases in a manner similar to that employed in tbc adenitis, i.e., moderate doses of shorter rays repeated at intervals over a long period of time.

We have also treated several paronychia which in general have responded in a manner similar to furuncles. Here again, when the infection has been recurrent over a long period of time, the results have not been as good. In the acute cases, the pain is relieved within 12 to 24 hours, and in most cases treated early, the process resolves so that incision is not necessary.

We have not attempted to analyze the group statistically because too many patients could not be located or did not recall the infection.

Gas Gangrene

Gas Bacillus infections are no doubt the most serious we have treated. It is perhaps the only one that is of itself very frequently lethal. From statistics it is seen that gas gangrene in civil life has a mortality of about 50% when treated by the conventional method and that the mortality in the American forces in France during the World War was similarly high, 48.5%. Obviously a method to reduce this mortality would be a boon to the treatment of gas gangrene.

Such an adjunct to the treatment of this condition was suggested in 1933 by Kelly³⁶ in a report on 6 cases treated with x-ray in addition to the conventional methods.

Before discussing the treatment of gas gangrene with x-ray, certain points must be made clear in analyzing the literature on the subject.^{19,63}

First, the accuracy of the diagnosis is not always apparent since the presence of the organism is of itself unreliable. In this respect, it is interesting to note that cultures taken from war wounds in 1916 were 81% positive. Studies on chronic leg ulcers in civilian life yielded 34% positive cultures; and cultures from intact skin were positive for *cl. welchii* in from 7 to 22% of the cases.¹⁹ It must be emphasized that positive cultures indicate only the presence of the organism. To get growth there must be devitalized tissues (favorable media) lying deeply (lack of oxygen).

The demonstration of gas in the tissues by means of the roentgenogram, likewise, may not be due to gas bacillus infection but rather to air forced into the tissues at the time of trauma or to oxygen liberated from hydrogen peroxide used in treatment, or due to other organisms (e.g., colon bacillae).

The diagnosis should rather be based on a combination of:

1. Clinical findings - e.g., odor, discoloration of tissues, discharge. Most important is pain and pulse elevation out of proportion to

- temperature rise, and crepitation.
2. Bacteriological studies.
3. Roentgenograms.

Once a diagnosis is established treatment may proceed along several avenues. The radical methods, e.g., surgical amputations have been attended by high mortality rates.²⁷ In traumatic cases careful and thorough debridement is essential. Adequate drainage and irrigation with oxidizing solutions should be used. Serum should likewise be administered.^{7,20} The use of sulfanilamide has not been adequately studied, but from recent experiments seems to have great possibilities.^{41,65,69}

How x-rays affect this infection is a moot question. Aside from the theories suggested in our introductory remarks, it is possible that x-radiation may liberate oxygen from the tissues irradiated.³⁹ However, this is a purely theoretical explanation and has no experimental foundation.

Since Kelly's original report there have been many other reports on the successful use of x-rays as an aid in the treatment of gas gangrene, with a pronounced reduction in mortality.^{27,37,38,49,63} However, many of these reports are of small series of selected cases, in many of which the diagnosis is to be questioned. Nevertheless one cannot lightly pass over Kelly's report of 123 cases of gas gangrene (on a non-vascular basis) treated with x-rays and having a mortality of only 8.1%. Here those with amputation had a 9.1% mortality while in those without the mortality was 4.0%. Kelly strongly advises against therapeutic amputation. Obviously when the extremity is very badly devitalized there is no choice.

Kelly's experiments on the treatment of gas gangrene in guinea pigs proved unsuccessful. Recent experiments with pigeons would also indicate that x-ray is of no value and that serum is best. However, this failure to experimentally substantiate the clinical reports may be due, as Kelly says, to unsuitable experimental animals.

patient sustained a simple fracture of the right tibia. The leg was immobilized in a plaster cast but subsequently the skin became blistered and the cast was opened. Temperature on admission was 101.8°. Pulse was 115. Skin was discolored over the right leg and edematous with numerous vesicles and bullae and marked swelling. Pulsations could not be felt in the vessels of the foot. On 11/30/30 the temperature rose to 104°. Roentgenogram revealed gas in the tissues. Cultures were positive. Immediate amputation of the right leg was done at the mid-thigh. Postoperative treatment consisted of sulfanilamide locally and by mouth. Gas antitoxin and blood transfusions were given. X-ray was delivered to the stump and lower abdomen - 75 r twice daily for 3 days. The patient however failed to respond and expired on the fifth postoperative day.

Case VI. , white male, age 54 - admitted on 12/7/39.

Twenty-six hours prior to admission he had sustained a compound fracture of the left tibia and fibula when his leg was caught in a pump belt. A foul exudate escaped from the open skin. Temperature was 100.2°. Pulse was 130. Roentgenological and bacteriological studies confirmed the presence of gas bacillus infection. Debridement was done. Sulfanilamide was instilled into the wound. Amputation was done the following day. Postoperative treatment consisted of gas antitoxin, sulfanilamide, by mouth and locally, and deep x-ray, 75 r twice daily for 3 days, at which time there was no further evidence of infection. The patient was discharged in good condition on 1/13/40.

Case VII. , white male, age 71 - admitted on 3/8/40. The patient gave a history of intermittent claudication for 5 years. Three days prior to admission there had been sudden pain in the left foot with discoloration of the skin. Examination revealed a ruptured popliteal aneurism. A mid-thigh amputation was done. The next day the patient's temperature rose to 104°. Pus was present at the wound, which was posi-

tive for *cl. welchii* on cultures. Gas was also demonstrated roentgenologically. The patient was given sulfanilamide, Dakin's irrigation, gas antitoxin, and deep x-ray, 75 r twice daily for 3 days. The infection subsided and the stump was well healed on discharge, 3/25/40.

Case VIII. , white male - age 56 - admitted on

3/13/41. Five days previously, the patient had fallen and sustained an abrasion of the right elbow. The arm became enlarged and on 3/12/41 his local doctor diagnosed gas gangrene and referred the patient here. There was swelling, discoloration of the skin and pain about the elbow. Temperature was 100.4°, pulse was 90. Roentgenograms revealed gas in the tissues about the elbow. Multiple incisions were made and Dakin's irrigations started. Sulfanilamide and gas antitoxin were also administered and deep x-ray therapy was started at once. The patient received 2 treatments daily for 3 days. His recovery was uneventful.

The technique employed for all these cases was 220 kv, 15 ma, $\frac{1}{2}$ mm Cu filter at 60 cm distance. HVL was 1.25 mm Cu, 75 r was delivered twice daily to the entire area involved.

Two of the 8 cases were on a vascular basis. In both the infection cleared up with treatment, but one died of other causes. (Case I). Five were treated with x-ray after amputation. Two of the remaining 3 recovered and one succumbed to the infection.

The group mortality was 38%. This is far short of what has been reported with the use of x-ray. However, in 5 of the cases roentgen therapy was given after other radical therapeutic procedures had been carried out.

Mastitis

The treatment of puerperal mastitis with x-ray has been lauded by many studying this subject.^{9,23,28} One reporter⁹ claimed 100% good results in

32 cases. In no case was there interference with lactation. He gave 160 r and then 100 r every other day for 3 treatments, generated at moderate voltage (135 kv).

We have treated 6 cases of puerperal mastitis, with good results in all. These patients were all hospitalized and the breasts were dried up by the conventional methods.

We attempted to maintain lactation in one case, but manual expression proved too painful and was stopped because of the danger of spreading the infection. In another case lactation was maintained and resolution of the process occurred within 48 hours.

Four patients did not require surgical intervention. One developed a small fluctuant area near the nipple after irradiation and the area was incised. The other patient was treated after incision and drainage had been instituted. This patient was seen after the condition had become well established.

One patient is of particular interest because of the multiple areas of involvement. The patient was a young primipara who developed a firm tender reddened area on the left breast a few days post-partum. The breasts were dried up and in a few days the infection subsided. A few days later, however, the patient noted pain and tenderness in an area on the right breast adjacent to the nipple which was red and firm. Temperature was 101°. She was treated with 100 r at 140 kv, 5 ma, $\frac{1}{4}$ mm Cu and 1 mm Al at 30 cm distance. This was repeated the next day. Temperature and pain rapidly subsided and in three days the right breast appeared normal. In the meantime lactation began in the left breast and another similar area was present at the medial portion of the breast. This was then given 100 r twice on successive days and responded rapidly in a manner similar to the other lesion. Two days later, another area of inflammation developed in the left breast which was treated similarly and again responded to therapy. Three days later there was no evidence of infection in either breast and temperature was normal. There has

been no recurrence since.

Parotitis

The treatment of surgical parotitis with radiation has been extensively used. It has been said, "Roentgen therapy in this condition seems to be about as specific as any therapy in medicine today and all other forms of therapy have not been at all satisfactory."³²

This same condition frequently accompanies debilitating diseases and we have therefore attempted to find some common factor in the surgical cases and the non-surgical cases.

The use of x-ray in the treatment of parotitis was suggested as early as 1925³¹ and in 1926, Heidenhain²⁸ reported 12 cases with 58% good results.

There are two possible modes of infection that come at once to our minds. The first, an ascending infection from the oral cavity via Stenson's duct to the parotid gland; the second, a haematogenous infection localizing in the parotid gland. The submaxillary and sublingual glands seem to be unusually immune to this type of involvement probably because of the different nature of these glands. They are of the mucous type, whereas the parotid is of the serous type. Other less plausible theories of the etiology of this condition are 1) the hormonal theory suggested because it was once thought that operations on the pelvic organs was the cause; 2) anaesthetic trauma. However, it is now universally accepted that the occurrence of postoperative parotitis has no relationship to the type of surgery or to the anaesthetic. It has been stated that no cases have been reported following operations on the cranium or face or when spinal anaesthesia had been used. Our own small series, however, will show examples to prove that these contentions are erroneous.

Moreover, these theories fail to explain the origin of parotitis in patients who have had no surgery performed.

Perhaps the most plausible explanation is that of salivary inhibition coupled with an ascending infection. A large percentage of the patients developing parotitis -- both postoperative and independent of surgery -- have had restrictions on food and fluid intake by mouth. This has come about either as a part of the therapy or as a symptom of the underlying condition. Thus, unless extraordinary care is taken with mouth hygiene, the mouth breeds many bacteria. It has been demonstrated that staphylococci, the organism most frequently found in material cultured from infected parotid glands, increase in number in the oral cavity when the mucous membranes are dry. It has also been shown by colony counts that staphylococci are more numerous in the mouth after surgery than before.⁶²

With failure of adequate salivary flow, the bacteria can readily ascend Stenson's duct to infect the parotid gland. These factors are further enhanced by dehydration, hyperpyrexia and the administration of opiates and atropine.

Parotitis is characterized by a sudden onset with elevation of temperature and pain and tenderness over the parotid gland. The area is tense and hard with a varying amount of surrounding edema. The orifice of Stenson's duct is usually inflamed and pus may be expressed from it. There is a moderate leucocytosis and the patient frequently complains of dysphagia.

Either one or both sides may be involved; it being generally agreed that bilateral involvement is of graver prognosis than unilateral involvement. Many start unilaterally, to later involve both sides.

The incidence of this complication has been reported to vary from .05% to .1% following all cases of surgery and is about ten times as frequent after bowel surgery. The mortality is greater in bilateral involvement and in cases having had major procedures.

The treatment may be divided into four groups: the first group consists of measures aimed to prevent the onset of parotitis; or "prophylactic treatment." Such

things as oral hygiene and salivary stimulation with lemons, mints, gum, etc. fall into this group. However, once the complication does occur, measures directed toward the relief of symptoms are in order. Cold applications have been advocated by some as an early measure. Others prefer hot applications from the start. Oral hygiene is necessary together with attempts to stimulate salivary flow. In this respect, some investigators have frowned upon the use of gum. They contend that in this infection as in others, rest is an important factor in promoting healing and for the relief of symptoms. Medications for the relief of symptoms should be used as indicated. Along with symptomatic treatment, conservative management should be undertaken, the object being to promote resolution or, failing in this, to localize the process. Conservative management may proceed along two lines. Either one or the other may be used, but preferably a combination of the two. The first is conservative surgical management; the other, radiation therapy. The former consists of such measures as rest, hot packs, salivary stimulation, dilation of Stenson's duct together with parotid massage, a procedure which is held by many to be objectionable.²¹

Radiation therapy may be accomplished by either radium or x-rays. We feel that x-rays, where a mobile unit is available or where the patient can be moved, is the method of choice.

Table II

X-RAY

1. Ready availability
2. Ease of administration
3. Uniform dosage
4. Short treatment time
5. No skin injury
6. Requires moving patient

RADIUM

1. Not readily available
2. Special equipment necessary
3. Unequal distribution
4. Longer period of treatment time
5. Possible skin injury
6. Patient need not be moved.

As a rule, x-ray in contrast to radium is more readily available. Further it can be more easily administered without special equipment as is needed when using radium packs. Moreover, a more uniform dosage is delivered to the entire area involved than can readily be accomplished with radium. In contrast to a radium pack which must be applied for hours, treatment of this condition with x-rays takes only a very short period of time. With the use of x-rays, one need fear no skin reaction when adequate depth dose is attained. On the other hand, with the use of a radium pack, the patient need not lie perfectly still nor need he be moved from his room. The most imperative factor in radiation therapy is its early administration. At the Mayo Clinic, it was found that when treatment was given within the first 12 hours the mortality was 25.4%. When given within 12-24 hours, the mortality increased to 33.5%. They have therefore made it obligatory that the roentgen department be notified of the existence of this complication in a patient immediately upon its discovery.¹⁵ Other institutions likewise consider the treatment of parotitis a roentgenological emergency.^{26,52,57,58} At this hospital we are prepared to treat such a condition at any hour, day or night. This is done either at the bedside with the mobile unit or in the x-ray department, depending on the patient's condition.

Various authors,^{1,28,34,60} report good results varying from 50% to 80% of the cases treated. The Mayo Clinic in another survey, reported that 50% of the non-treated cases suppurated and required surgical drainage, whereas this had to be done in only 10% of the irradiated group. The group mortality was 20% in those irradiated, while 39% of the non-irradiated group died.⁷

We have divided our cases into three groups:

1. 31 cases post-operative, treated with radiation
2. 16 cases non-operative, treated with radiation
3. 13 cases post-operative and non-operative, not treated with radiation.

Fifty-five per cent of the first group

died; however, 78% responded to therapy and the parotitis cleared up. Of the second group, 44% died, but only 31% failed to respond to therapy as far as the parotitis was concerned. In the non-treated group there was a 54% mortality and the same percentage of these patients failed to respond to therapy.

Table III

	Cases	% Good Results
Post-operative, treated	31	78%
Non-operative, treated	16	69%
Untreated	13	46%

Rankin and Palmer⁵⁷ pointed out that there was an appreciable difference in mortality between the cases having unilateral involvement and those having bilateral parotitis. An analysis of our cases substantiates this contention as it shown in the following table:

Table IV

	<u>Unilateral</u>		<u>Bilateral</u>	
	<u>No.</u>	<u>Mort.</u>	<u>No.</u>	<u>Mort.</u>
Postoperative, treated	19	42%	12	58%
Nonoperative, treated	10	30%	6	66%
Not treated	10	50%	3	66%
Total, U.H.	39	42%	21	64%
Rankin & Palmer	33	36%	16	56%

Of the 34 cases that had surgery performed, 12 (35%) had spinal anaesthesia and 50% had gas anaesthesia. The remainder had local infiltration. Thus, the type of anaesthesia seems to play no part in the occurrence of this complication.

Forty-four per cent (44%) of this group of 34 patients had surgery on the gastro-intestinal tract. One case had a craniotomy, another a neurectomy. The remaining 17 cases occurred after various

types of surgery from the simple insertion of a Kirschner wire to a third stage thoracoplasty. Only 3 cases had surgery to the pelvic organs in the female.

There was no sex difference in the operated group. Of the 34 cases, 17 were males and 17 were females. In the non-operative group of 26 cases, 58% were in males.

The average age in both the postoperative and non-operative groups was 56 years with a range from 13 years to 81 years.

So, in recapitulation, our cases showed no correlation with sex, age or type of anaesthesia. Surgery on the gastro-intestinal tract represented the largest single group, but all types of surgery may be complicated by parotitis.

It is interesting to note that 70% of the cases that developed parotitis unrelated to surgery occurred in patients who were not taking food or fluids adequately by mouth; as for example in bowel obstructions, severe generalized infections, or marked debility. Likewise, 70% of the postoperative patients did not take fluids well by mouth. In other words, 70% of the 60 cases that developed parotitis occurred in patients in whom factors existed to predispose to oral sepsis and in whom salivary stimulation was inadequate.

This group of cases was collected over a period from 1930 to 1941. Almost all of them were treated symptomatically by the application of heat and analgesic drugs. A very large percentage were in addition given salivary stimulants such as gum or lemon. A few had attempts at aspiration and most had special oral hygienic measures. Surgical drainage was required in 30% of the cases not treated with radiation and in only 15% of those treated. Many of the cases treated in the last few years were also given drugs of the sulphonamide group. We were unable to note any definite evidence of deleterious effect by the combined use of x-radiation and these drugs. Walker and his associates⁷² also failed to note any ill effects from the combined use of these two therapeutic agents in a single case of

parotitis so treated. However, recently, Elocks and Kerr²² showed by experiments on mice that the combined use of x-rays and sulfonamide drugs increased the mortality over that obtained when either agent was used alone. Vitro experiments on the other hand showed that the action was enhanced by combination of these agents. Our series is too small and has not been studied carefully enough in this respect to permit any definite conclusions.

As for the radiation therapy employed, only one case was treated with a radium pack. This patient received 700 mgh to one side and 800 mgh to the other side. However, the patient died within 24 hours after therapy and the results could not therefore be evaluated. The remaining 46 patients all received x-radiation. 37 were treated with 200 kv, 30 ma with 0 to $\frac{1}{2}$ mm Cu filter at 50 to 60 cm distance. The dosage has undergone somewhat of an evolution from small single doses of 50 to 100 r, then moderate single doses of 200 to 300 r; still later similar moderate doses of 100 to 150 r repeated two or three times on successive days. Of the 9 remaining patients, 6 were treated with 220 kv, 15 ma, $\frac{1}{4}$ mm Cu filter at 50 to 60 cm distance and 3 were treated with the mobile unit at the bedside. These patients were treated with 140 kv, 4 ma, 1 mm Al and $\frac{1}{4}$ mm Cu filter at 30 cm distance, 100 r being given at each treatment and repeated 3 to 4 times, as necessary.

Dividing the treated cases into groups depending on the method used, we find that 10 patients were treated with small single doses and that 70% responded to therapy although 50% of this group died. Twenty-two cases were given single moderate doses. Sixty-four per cent of this group showed good results with a 40% mortality. Only 4 cases were given moderate repeated doses with 75% responding, although 2 patients died. Of the 10 patients receiving small repeated doses 70% got good results, but the mortality rate here was 70%.

Table V

	<u>No.</u>	<u>% Good Results</u>	<u>% Mortality</u>
Small single doses	10	70%	50%
Moderate single doses	22	64%	40%
Moderate repeated doses	4	75%	50%
Small repeated doses	10	70%	70%

With such few cases in each group we do not feel that any definite conclusions can be drawn as to the best method to employ. From these figures there would not seem to be a great deal of difference.

In summary, roentgen therapy in addition to other conservative therapeutic measures, in our series of cases increased the percentage of good results as far as the lesion itself was concerned from 46% in untreated cases to 75%. However, no change in the mortality rate was noted.

Bilateral lesions are of graver prognostic significance than unilateral.

Seventy per cent of this series of cases occurred in patients in whom there existed factors favoring oral sepsis and inadequate salivary flow.

Surgical drainage was necessary in only 15% of cases irradiated as compared to 30% in non-irradiated cases.

Various methods of x-radiation were employed, but no significant difference in results could be noted.

Pelvic Inflammatory Disease

The use of x-radiation in the treatment of pelvic inflammations has not been extensively studied in this country, but what has been done seems promising. The same is true of the work abroad.⁵³

We have treated only 3 cases, but the results have been favorable enough to warrant reporting this group.

The first case was that of a white female with a pelvic inflammatory condition which had followed delivery of a child one month previously. The abscess was incised and drained through an abdom-

inal incision. Therapy consisted of supportive measures, diathermy, and x-ray. Later a rectal communication was demonstrated. Drainage has persisted to date and no further roentgen therapy has been given.

The second patient also had a pelvic inflammatory process attributable to pregnancy. Laparotomy elsewhere confirmed this diagnosis and following surgery the patient developed a persistently draining sinus. Roentgen studies revealed the presence of an intestinal fistula and left hydronephrosis secondary to pressure from pelvic abscess. Attempts to enlarge the tract were made and the abscess packed with iodoform gauze. After conservative care for almost 2 years, the pelvic mass although smaller, was still present and draining. She was then treated with irrigation of sulfanilamide and x-ray therapy was given, 10% S.E.D. being given on two occasions. The mass subsequently diminished in size and drainage became much less profuse. Two months later, drainage had stopped. There was still induration in the left adnexal region and persistent hydronephrosis.

The third patient was a 15 year old girl who developed a pelvic abscess following a ruptured appendix. She developed a spontaneous colpatoxy and under conservative management the drainage decreased in amount and finally stopped. Then the appendix was removed and the patient felt well until about one year later when she again developed signs of pelvic inflammatory disease. The mass was incised and drained through an abdominal incision. She was then given 10% S.E.D. to the pelvis. This was repeated 2 weeks later. Examination 3 months later showed that drainage had ceased and the mass was smaller. Patient

was gaining weight and was afebrile.

The technique used in treating these patients is as follows: 10% S.E.D. is delivered to the center of the pelvis through anterior and posterior pelvic portals 20 x 20 cm in size. The rays are generated at 220 kv, 15 ma, at 70 cm distance with 1 mm Cu filter.

Since our experience is so limited, all we can say is that x-radiation seems to be a valuable adjunct to the therapy of pelvic inflammatory disease and would be well worth further trial.

Peritendinitis

We have treated a group of 50 patients with peritendinitis. Many of these have been diagnosed bursitis; but, since these bursae were closely associated with tendons we have included them under this heading. As a matter of fact, this condition has been referred to in the literature as para-arthritis (De Lorimier), bursitis calcarea, and peritendinitis calcificans (Gleichman) and has often been wrongly diagnosed as neuritis, myositis, or arthritis.

Reports of various investigators would indicate that roentgen irradiation for this condition, if accurately diagnosed, is more gratifying than any other method of therapy.^{10,25,35,46}

Table VI

	<u>No.</u> <u>Cases</u>	<u>Good</u> <u>Results</u>	<u>Per</u> <u>Cent</u>
Lattman	20	15	75%
De Lorimier	36	36	100%
Gleichman	10	10	100%
University Hospitals	50		65-75%
	(50% follow-up)		

Many methods of therapy have been employed and these may be classified as:

1. Conservative - diet, heat, rest, etc.
2. Physical therapeutic
3. Injection methods
4. Surgery
5. Roentgen therapy

It is to be noted that as a rule, an acute episode of peritendinitis will, under conservative management alone, regress in several weeks.

The other therapeutic methods often hasten recovery, but from reports cited, it would seem that when an accurate diagnosis is made x-radiation offers the best and most prompt relief.

The etiology of this condition is often obscure but predisposing factors may be: 1. trauma, 2. overuse or unaccustomed use, 3. focal infection, and 4. metabolic disturbances. De Lorimier found chilling to be a prominent factor in his group collected in a tropical climate. Trauma or unaccustomed use seemed to be a prominent feature in our series.

The demonstration of calcium deposits about the involved tendons aids in making the diagnosis. However, calcium need not be demonstrable in this condition.^{35,46,52} The results obtained by therapy show no relationship to the presence or absence of calcium.

Of the 50 cases treated with x-ray at the University Hospitals, 19 (38%) were in females, and 31 (62%) in males. Sixteen per cent of the entire group (25% of the males) were physicians. The shoulder was the most frequently involved, representing 78% of the cases treated. The remainder of the cases included the hip, lumbosacral, phalangeal and wrist joints. Trauma, as with unusual exercise, seemed to be an important etiological factor. By this mechanism an old quiescent peritendinitis frequently flared up.

We were able to get follow-up information from about half of these patients. From these data, it would seem that favorable results were obtained from x-ray alone in 60% of these cases. Usually relief of pain was prompt, coming on in from 12 to 48 hours. Another 15 to 20% showed moderate improvement with x-rays alone or together with other types of therapy.

Although not all cases treated were studied roentgenographically, our impression that the presence or absence of cal-

cium is in no way related to the symptoms or to the results obtained from therapy, concurs with that of the investigators previously cited.

We feel that rest and local application of heat in combination with roentgen therapy enhances regression here just as it does in other inflammatory processes. Best results are attained in the acute stages, but several chronic cases have responded very rapidly and remarkably well.

In general, treatment was given with rays generated at 200 kv peak, 30 ma, 60 cm distance, with $\frac{1}{2}$ mm Cu filter, HVL was .9 mm Cu and a dose of 250 r to 2 or 3 fields were given. This may be repeated in a month or two in the chronic cases.

Pulmonary Inflammations

a. Bronchiectasis. It has been stated that roentgen therapy in moderate doses for chronic suppurative bronchiectasis is feasible and successful, resulting in symptomatic improvement in a considerable proportion of cases. Often there is practically complete cessation of symptoms without recurrence.

It has been supposed that the x-rays act on the bronchial glands in a manner similar to their effect on the salivary glands. As a result, bronchial secretion is inhibited. This theory has not been well substantiated. Others believe the action to be on the inflammatory process by methods outlined earlier in this paper.

A fairly large series of cases was reported from Mount Sinai Hospital with 45% of their treated cases greatly improved.⁶ This was a selected group which had been observed for some time and had been proven by bronchoscopy and bronchography. None of them were acute cases since the investigators believed that secondary infection as with acute upper respiratory infection may make an otherwise "dry" bronchiectasis "wet" temporarily.

From 1936 through 1939, 24 cases of bronchiectasis were treated with x-radia-

tion at the University Hospitals. The average age was 34 years with ages ranging from 14 years to 57 years. Symptoms averaged 8 years at time of treatment with a range varying from 2 months to 20 years. Sixty-six per cent of the cases treated had unilateral involvement. Some of these patients had lipiodol instillations, postural drainage, and bronchoscopic aspiration. All were treated symptomatically by medicinal means. The diagnosis was verified by bronchography in every case.

Table VII

Bronchiectasis

	<u>Excellent Result</u>	<u>Temp. Imp.</u>	<u>No Effect</u>
No.	4	8	12
%	17%	33%	50%

Of the 24 cases 4 (17%) were symptomatically improved and have remained improved to the time of this communication. However, only 2 of these showed radiological evidence of improvement after therapy.

Eight patients (33%) showed temporary improvement and then had recurrence of symptoms after a few months. The remaining 12 patients (50%) noticed no improvement or claimed to have been made worse by the treatment.

Of the 4 patients who improved, 3 had symptoms of less than a year's duration. The other patient had had difficulty for 10 to 15 years. The other groups showed no relationship between duration of symptoms and results obtained. Likewise no correlation between results and location and extent of involvement could be made.

We concluded that little was gained with roentgen therapy for this condition and consequently have treated no such cases since January, 1940. However, with 17% giving favorable results this method of therapy may be worthy of trial in selected cases.

We administered 400 r to 3 fields or 600 r to 2 fields depending on the location of the lesion using 200 kv, 30 ma, 60 to 70 cm distance with 1 mm Cu filter. This was often repeated in 6 weeks.

b. Pneumonia. Our experience in the treatment of pneumonic conditions has been very meagre. However, because of the recent enthusiastic reports^{54,55}, we feel that the treatment of such conditions should be mentioned here.

Treatment has been advocated for both acute and unresolved pneumonias. In 1907 Edsall and Pemberton¹⁸ reported on x-ray therapy in 3 cases of unresolved pneumonias. Their first case was treated in 1905. They were enthusiastic about the results obtained and advocated further investigation of this method of treatment. Other reports appeared later^{44,49,58,71}. These likewise noted response to x-radiation in selected cases of delayed resolution following pneumonia. In fact, in 1916, Quimby said, "No pathological process in the body responds quicker to x-ray exposure than non-resolution following pneumonia." Furthermore, the experimental studies of Fried on artificial pneumonia in guinea pigs bears out these contentions.²⁴ He showed that the irradiated lung has less infiltration, less hyperemia, and that edema, abscess formation, and exudation are less prominent.

More recently, the treatment of acute pneumonia has gained prominence through the reports of Powell^{54,55}, who has studied over 100 cases of acute lobar and broncho pneumonia. His cases did not receive serum or chemotherapy and of 105 cases of lobar pneumonia of various types, only 5 died. His results with bronchopneumonia were not as good, nor as uniform, but in 30 cases he felt that the mortality had been substantially reduced. It must be pointed out, however, that these studies were not controlled and it might well be that the disease at the time of this study was mild and carried a naturally low mortality. Nevertheless, the clinical improvement noted by Powell could not be pure coincidence and must be borne in mind when evaluating his results.

We have treated 5 cases of pneumonia. One, a five week old infant with chronic unresolved bronchopneumonia failed to respond to any form of therapy and at autopsy was found to have congenital heart disease together with multiple other congenital defects. Two were lobar pneumonias in adults. One recovered slowly. The other was treated when moribund and expired. The remaining two patients were infants with bronchopneumonia who recovered after conservative therapy and x-radiation.

Our technique has differed somewhat from that of Dr. Powell who uses softer radiation. We have administered rays generated at 200 kv, 30 ma, at 60 to 70cm distance with $\frac{1}{2}$ mm Cu filter, giving r.

c. Lung Abscess. We have treated two cases of lung abscess: one of which showed no change after irradiation, and the other showed some improvement.

The only reference in the English literature to the treatment of this condition with x-radiation is by Quimby in 1916,⁵⁶ who describes a favorable response in 2 cases, and the diagnosis is presumptive from the history given.

Obviously any statement as to the effect of x-radiation in this condition would be ill-founded, yet it may be worth a trial, since other methods of conservative therapy are not very successful.

Sinusitis

We have treated 16 cases of paranasal sinusitis, 38% of which were in physicians. Although this group is too small to be of statistical importance, we found that about 75% of those treated obtained temporary relief. Several of these patients were followed for over a year without recurrence of symptoms. Since, as has been pointed out, a large percentage of our cases were in physicians and further, because no attempt at study of this infection was being made our data is very incomplete. From the literature, however, we discover that when cases are carefully selected radiation therapy is of decided advantage in the

treatment.^{17,33,58,66} Osmond⁵¹ treated sinusitis with x-radiation as early as 1916. He pointed out that best results are to be obtained in the subacute stages when there is a profuse watery discharge. These patients have thickened mucous membranes lining the sinuses as can be demonstrated roentgenologically. There should be adequate drainage from the infected sinuses when giving roentgen therapy, and if this is not present, it should be instituted by surgical methods.

Besides this clinical evidence, there are experimental studies to support the rationale in roentgen therapy for sinusitis. Butler and Wooley⁸ produced infection in the frontal sinuses of cats and then irradiated them. They found that the irradiated sinuses as compared to a control group not irradiated showed more macrophages and fewer lymphocytes to be present and an infection of much less severity. This group corresponded to a subacute infection since treatment was given 3 weeks after infecting the sinuses. In a similar group treated 1 to 3 days after infection these investigators found that x-radiation produced an early destruction of lymphocytes and some fibrosis. Their clinical studies on 700 cases showed 36% to have obtained complete relief, 58% to have improved and only 9% to have not benefited by therapy.

Koch⁴³ has carried out a similar clinical investigation irradiating only one side and later operating upon the patient. His studies show changes very much like those found in the cats.

It should be stressed that to get the best results from roentgen therapy, careful examination of these patients is essential. Only selected cases should be treated and every effort must first be made to rule out allergy as the basis of the sinus infection, since such cases due to allergies will not respond to irradiation.

The technique we have employed is somewhat different than others since we have used somewhat harder rays. At 200 kv to 220 kv peak with $\frac{1}{4}$ to $\frac{1}{2}$ mm Cu filter,

60 cm distance we have given 150 to 250 r and repeated once in some instances.

Tonsillitis and Pharyngitis

The treatment of infections of the lymphoid tissues of the pharynx has not been extensively used. However, there is no reason why such inflammations should not respond to irradiation just as infections in other regions do. Still, few patients ever reach a roentgenologist for treatment of such conditions and therefore, the value of this therapy is little known.

True, acute tonsillar and pharyngeal inflammations as a rule rapidly subside with conservative medical management. In the subacute or chronic inflammations, on the other hand, roentgen therapy may frequently eradicate an otherwise resistant infection.

In chronic tonsillitis irradiation does not produce as uniformly good results as does surgery and should be limited in such instances to cases where surgery is refused or contraindicated. Patients with hypertrophied lymphoid tissue and recurrent upper respiratory infections and those who after tonsillectomy continue to have recurrent sore throats and colds and are below par physically, respond well to roentgen therapy.

Lymphoid tissue elsewhere in the pharynx responds in a similar manner and frequently symptoms referable to the upper respiratory tract, e.g., frequent colds and hearing loss, may be relieved by irradiation of the hypertrophied lymphoid tissues.^{30,59,61,75}

Roentgen therapy for tonsillitis was once in great vogue; however, because of injudicious use, the "pendulum" swung away and roentgen therapy for this condition fell into disrepute. Now we believe it has reached a stationary position where roentgen irradiation in selected cases, as mentioned, should produce favorable results with no damage to normal structures in a large percentage of cases.⁵³

We have treated 45 cases of lymphoid hyperplasia with and without infection. This group may be divided into three: First, 6 patients treated for tonsillitis with x-rays because they refused surgery or because surgery was contraindicated. Several of these patients were extremely ill of other conditions and the results are difficult to evaluate. Second, 7 patients who had recurrent tonsillitis after other methods of therapy including surgery. Follow-up information in this group is inadequate to draw definite conclusions, but several of these patients were greatly benefited. Third, 32 cases were treated for pharyngeal lymphoid hyperplasia because of recurrent colds or hearing loss. Our impression is that this group is greatly improved with x-radiation. However, those having hearing loss due to mastoid surgery got only slight if any improvement.

We have treated through two portals to the pharyngeal area. 150 to 250 r is delivered at 200 kv, 30 ma, with $\frac{1}{2}$ mm Cu filter at 60 cm distance. This dose may be repeated again in several weeks or months as indicated. Intraoral fields have been used by some therapists, but we have not used that method here.

Summary

Two hundred and seventy-eight cases of inflammatory conditions have been reviewed. Tuberculous, fungus, and virus infections have been excluded from this study as have other small groups or single cases of rheumatic endocarditis and arthritis, where we have obtained poor results.

The conditions may be divided into 3 main groups: the first, those conditions in which x-radiation produces very good results, and which include carbuncles, furuncles, hydroadenitis, paronychia, mastitis, peritendinitis, and parotitis; the second, those in which fair or temporary improvement is obtained such as adenitis, gas gangrene, pelvic inflammatory disease, sinusitis, lymphoid hyperplasia, pneumonia, and bronchiectasis; and third, those inflammations where a poor response may be expected as in in-

flammations of bones and joints, lung abscess, and such miscellaneous infections as arthritis, rheumatic endocarditis and nephritis.

Conclusion

Roentgen therapy has a definite place in the treatment of inflammatory conditions; and is all too often neglected because of a lack of clear understanding as to its usefulness.

In reviewing the relatively small series of cases with a variety of inflammatory conditions treated at this hospital we have concluded that x-ray therapy is a valuable adjunct to the treatment of such afflictions; that by careful selection of cases in some conditions or early therapy in others, the results of treatment can be improved.

We have learned that some inflammatory conditions respond poorly, if at all; others obtain temporary relief and still others are greatly improved by irradiation. With this in mind, we feel that x-radiation in selected cases of inflammatory conditions, not as the sole treatment, but as one accessory method of therapy, has much to offer.

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-
- V. CARCINOMA OF THE ESOPHAGUS
- Solveig M. Bergh
- Carcinoma of the esophagus has a high mortality rate. Without treatment it is 100% fatal and even with intensive therapy the results have not been encouraging.
- Incidence
Probably 4 to 5% of all cancer deaths in the United States are due to carcinoma

of the esophagus. In New York City it causes 300 deaths per year or $3\frac{1}{2}\%$ of all cancer deaths (Watson). In the United States it causes over 2000 deaths per year (Baum).

Etiology

The etiology is obscure but it is believed that poor teeth, intraoral sepsis, repeated trauma, thermal irritation, scars of old lye burns, and congenital defects may be predisposing factors.

Age and Sex Incidence

The ratio of the disease in men and women is about 4 or 6 to 1.

Souttar reports that 96% of the cases in men occur after the age of 45 and 88% after 50. In women the incidence is about the same between 40 and 75 years of age. Of 100 cases in his series, 80 were men and 20 were women.

Location

Most of the lesions occur in the middle third of the esophagus, with the lower third next and the smallest number in the upper third. The areas of physiologic narrowing are the common sites of carcinoma.

Pathologic Types

About 90% of the lesions are of the squamous cell type. Adenocarcinomas also occur but most of these are at the distal end of the esophagus and usually represent an extension from a carcinoma of the cardiac end of the stomach. Jackson, however, reported 935 cases, only 507 of which were squamous, 401 adenocarcinoma, 7 sarcoma and 1 endothelioma.

Grossly, carcinoma of the esophagus may be divided into three general types:

1. Bulky, polypoid type which causes obstructive symptoms.
2. Shallow ulcerating type which may cause mediastinal involvement, and
3. Infiltrating scirrhous type which causes fixation of the esophageal wall.

Spread

Spread of the lesion occurs by direct extension, lymphatics, blood stream, or implantation. In direct extension, the lesion grows vertically in the esophagus infiltrating the submucosa and muscularis and later ulcerating and invading neighboring organs. Lymphatic spread is usually relatively late. Hellsley did postmortem examinations in 70 cases and in 64% found the lesion confined to the esophagus without any secondary deposits in the lymphatics or other organs. In 6% the lesion had spread to the regional lymph nodes without distant metastases, and in 30% distant lymph nodes and other viscera were involved. Blood stream extension is rare. Souttar reports a postmortem of a case with a large carcinoma of the esophagus with metastasis to the cerebellum. Implantation is also rare. McGibbon reports three cases in which carcinoma later developed in a tonsillar pillar, tongue, and another site in the esophagus which he believed to be due to implants.

Symptoms

The onset is insidious and usually six to eight months pass before the patient seeks medical advice. The most common symptom is dysphagia. Difficulty in swallowing solids is noticed first but when the obstruction becomes more complete, the swallowing of semisolids and later of liquids also becomes difficult. Regurgitation is a frequent symptom. Some patients notice a feeling of substernal weight or pain as an early symptom. In a few cases, patients complain of hoarseness because of involvement of the recurrent laryngeal nerves. The appetite remains good but the patients lose varying amounts in weight because of starvation.

Diagnosis

The diagnosis of carcinoma of the esophagus usually is made late because of late appearance of symptoms. Any individual over 40 years of age having difficulty with swallowing should undergo a careful examination. The patient should have the benefit of radiographic examination consisting of a fluoroscopic study. A thin barium mixture should be used first in any case with dysphagia so

that complete obstruction does not result. Thicker barium may be used later if indicated. X-ray examination usually will disclose the site of the lesion, the extent, and the degree of obstruction.

Esophagoscopy examination should be done also. Lesions too small to be demonstrated by x-ray may be found. Jackson says a lesion the size of an orange seed can be recognized through the esophagoscope. Esophagoscopy discloses the gross type and anatomic location of the lesion, and permits the removal of tissue for microscopic examination.

Duration of Symptoms

Watson, in 208 cases, found the average length of life after onset of symptoms to be 10.5 months and after admission to the hospital 4.8 months. Souttar published similar figures.

Present Status

No form of carcinoma in any location is attended by a more serious prognosis. Curability is similar to carcinoma of the pancreas or lung. Treatment is usually unsuccessful no matter how radical. There are several reasons for this:

1. The obscurity of the symptoms lead to a late diagnosis.
2. The esophagoscope is used too seldom. There are too few men trained to use it so this examination is available only at the larger clinics.
3. The disease is highly malignant. There are early adhesions to neighboring organs.
4. The lesion is usually inoperable by the time the diagnosis is made.
5. The patient is frequently not a fit subject for radical treatment of any kind due to age and inanition.
6. The esophageal wall frequently perforates early.
7. It is difficult to get an adequate

dose of irradiation to the lesion. This is because the wall of the esophagus is so thin that perforation may occur.

8. Surgery of the esophagus has not yet been highly developed.

Complications

Perforation is the most common complication. This occurs into the trachea and results in pneumonia or gangrene of the lung. Hemorrhage is another important complication and it may occur from the tumor or as a result of erosion into surrounding large blood vessels. Souttar reports 18 postmortem cases in which ten died from direct involvement of the respiratory tract and five from hemorrhage and one from a secondary growth in the brain.

Treatment

Pack and Livingston outline the present methods of treatment as follows:

A. Non-surgical

1. Custodial care
2. Dilatation
3. Intubation
4. External Radiation Therapy
5. Intracavitary Irradiation

B. Surgical

- I. Endoscopic treatment
 1. Bipolar endotherm excision of rare polypoid tumors
 2. Electrocoagulation in one or several stages
 3. Interstitial radium therapy
 4. Endoscopic adjustment of radium tubes
- II. Operative Treatment
 1. Gastrostomy for feeding and palliation
 2. Gastrostomy for retrograde bouginage or retrograde insertion of radium
 3. Intrathoracic or intracervical exposure of esophagus for interstitial implantation of radium or radon.
 4. Esophagectomy

5. Anterotheracic esophagoplasty.

A. Non-Surgical.

1. Custodial Care. Care for the incurable cancer patient consists of good nursing care, diet, transfusions, etc.

2. Dilatation. This is done by passing sounds over an anchored silk thread. It sometimes is used alone as treatment to relieve obstructive symptoms or may be combined with other forms of treatment. It is one of the most valuable forms of palliative treatment, enabling the patient to eat.

3. Intubation. Intubation consists of placement of a tube at the site of the lesion to keep the lumen of the esophagus open. It is seldom used.

4. External Radiation Therapy. In most cases, irradiation therapy has been only palliative. A few encouraging reports have been made concerning patients who remained well for varying lengths of time, but recurrence is the usual end result. Watson reports two cases treated with heavy protracted doses of x-radiation resulting in perforation of the esophagus and death from suppurative mediastinitis. At autopsy in these cases there was no evidence of local tumor nor metastasis. Watson also reports a series of 68 cases. Thirty-three patients were alive at the time of writing. Eight patients survived a year or more after x-ray therapy alone and one was well for two years but finally developed a recurrence. He reports that his patients treated with divided dosage of x-ray were followed by symptomatic and radiographic evidence of improvement.

In no case in Watson's series was there any pulmonary fibrosis following the treatment. No change was observed in the erythrocyte count and only a slight temporary decrease in the leukocyte count.

Malcolmson and Malcolmson described a patient with a three year cure who

developed a slight constriction of the esophagus. On esophagoscopy examination a cicatricial contraction was noted but there was no evidence of tumor.

5. Intracavitary Irradiation.

X-ray therapy and radium are frequently used together. Radium is applied in tandem in the esophagus. It may be placed at the site of the lesion under fluoroscopic control or, if a gastrostomy has been done previously, by combined gastroscopy and esophagoscopy.

The exact method of its use varies in different clinics. The best results from radium treatment are reported by Guisez. He inserted radium in daily doses for about two weeks and has reported cures of 11, 10, and 5 years.

Crump and Kasabach report a case in which the combined treatment was used. A stricture remained at the site of the lesion but on esophagoscopy examination no neoplastic tissue was seen. The patient died about three months later. Death was thought to have resulted from an anaesthetic. No evidence of tumor was found at postmortem examination.

Most reports, however, are not encouraging. The patients may live one or two years but recurrences are the rule.

B. Surgical

I. Endoscopic

1. Endotherm Excision. This may be used for rare, small polypoid tumors but there is no report of a cure from such a procedure.

2. Electrocoagulation. This method is also palliative. It relieves obstruction for a time but offers no hope for cure. Wright and Hadfield report a case in which this treatment was used. The patient died seventeen days later from heart failure. On postmortem examination the entire projecting lesion was found to be gone and recent granulation was present. There was inflammation in the upper surfaces and the tumor tissue was still present in the deeper tissues.

3. Interstitial Radium Therapy.

Various types of instruments have been devised with which to implant radon in and around esophageal lesions. Colledge reports a case well two years after implantation of radon. The lesion is implanted through the esophagoscope. Usually the upper part can be implanted well, but it is difficult to reach the lower border.

II. Operative Treatment.

1. Gastrostomy. This is done in some late cases for the purpose of feeding. Simple dilatation however has largely replaced gastrostomy for this purpose.

The operation sometimes is done to build up patients for more radical treatment if there is any chance of a cure. In lesions causing almost complete obstruction and where x-ray therapy is contemplated, gastrostomy may be done for feeding in case the swelling should cause a temporary complete obstruction.

Gastrostomy also is used as a means of retrograde bouginage and radium insertion.

2. Exposure for Radon Implantation. This procedure is done for lesions high in the cervical esophagus where the tumor can be visualized readily and radon can be implanted in and around it.

3. Radical Surgery. The lack of satisfactory results from other types of treatment has stimulated activity along the surgical line.

The first successful case was that of Torek operated on in 1913. This patient was well for 13 years, then died of pneumonia at the age of 80.

The next successful case was that of Lilienthal in 1921. This patient lived 16 months, then died of recurrence.

Eggers has performed thirteen esophageal resections. Four patients lived several months (30.8%) and one lived more than a year.

Turner also has had a successful case

with the patient surviving more than a year.

More recently, reports by Garlock show encouraging results. He has operated upon 17 cases. Six proved to be not removable, giving a percentage of resectability of 64.7%. Eleven were subjected to radical surgery. Three died - one of tension pneumothorax, one of cerebral hemorrhage, and one from post-operative shock. Eight patients survived. One of these died of recurrence in the superior mediastinum 23 months later, one died of coronary disease 3 months later, and the third died with generalized metastases in one year. Five of the patients were alive and well at the time the article was published, at $3\frac{1}{2}$ years, 11, 7, 6, and 1 months post-operatively.

We have reviewed the cases of carcinoma of the esophagus from the files of the University Hospitals from 1911 to the present time. One case of sarcoma also is included.

Number of cases	126
Sex - Male	95
Female	31
Age - Oldest	87 yrs.
Youngest	39 (carc.)
	27 (sarcoma)
Average	61.6 yrs.
Location of lesion	
Upper third	33 cases
Middle third	45
Lower third	30
Lesion in Cardia with involvement of distal esophagus	18

Length of Lesion

The length of the lesion is not obtainable in all cases. In many, complete obstruction to the passage of barium was noted so the lesion itself could not be visualized. Of those in which the length was obtainable the findings were:

Longest lesion	16 cm
Shortest lesion	1.5 cm
Average	6.8 cm

Biopsy

Reports are not complete but in those recorded there were:

Squamous Carcinoma	42
Adenocarcinoma	6
Sarcoma	1
Unsatisfactory	2
Necrosis	3
No tumor seen	2

Some of the squamous carcinoma were graded, the classification being:

Grade II	7 cases
Grade III	13 cases
Grade IV	4 cases

Symptoms

The most common symptoms were dysphagia and weight loss. These were the presenting symptoms as well. Others also are listed.

Dysphagia	105 cases
Weight loss	90
Substernal pain	15
Vomiting	10
Hematemesis	3
Regurgitation	8
Hoarseness	3
Tumor of neck	2

Duration of Symptoms and Disease

The average duration of symptoms before patients came to the hospital was $5\frac{1}{2}$ months. Patients lived an average of 7.4 months from onset of symptoms until death and 2.7 months after onset of treatment.

A classification has been made of the types of treatment which have been used and the number of patients having had each type. The same patient may be classified in more than one of the following groups:

Refused treatment	2
Tube feeding	4
No special treatment because of metastases	4
X-ray therapy	31
Radium	26
Dilatation	46

Tracheotomy	6
Gastrostomy	42
Exploratory	4
Radical surgery	4

Gastrostomy

Gastrostomy was the only form of treatment in 21 cases. Length of life in this group of 21 was:

Longest	3 months
Shortest	1 day
Average	22 days

Many of these patients were in the terminal stage of the disease at the time surgery was done.

Dilatation

In 24 cases, dilatation was the only type of treatment used. The average length of life was $3\frac{1}{2}$ months. At present, dilatation frequently is used but it usually is combined with other forms of treatment, especially x-ray and radium.

Surgery

In four cases, exploratory operations were done but because of evidence of extension and metastases, radical operation was not performed. One case with invasion of the trachea lived 8 days and another 2 days after surgery. One patient in which there were mediastinal metastases lived 3 months. The fourth patient lived one month following a gastrojejunoplasty. On postmortem examination there was perforation of the esophagus with mediastinitis and there were metastases to the liver, lungs, and stomach.

Four patients had radical surgical procedures. Three of these died the day following surgery, one from edema of the epiglottis, the second from perforation of the esophagus, atelectasis and pulmonary edema and the third from pneumonia and pulmonary effusion. The fourth patient lived six months but then died from recurrence of the carcinoma in the esophageal stump. The carcinoma invaded the neck causing perforation of the

carotid artery with fatal hemorrhage resulting.

Irradiation

X-ray therapy alone was used in 17 cases, radium alone in 12 and a combination of the two in 14 cases.

X-ray alone. By x-ray alone is meant that no other irradiation was used. Some of the patients in this group received dilatations as well as the x-ray. One patient in this series is living 3 months after completion of x-ray therapy. She is receiving dilatations periodically. The length of life in other patients in this group after therapy was:

Longest	1½ years
Shortest	1 month
Average	4.8 months

Radium. Radium emanation was the only form of irradiation in 12 cases. These patients have expired but the exact date of death is not known in 2 cases. Length of life of the others in the group was:

Longest	2 years
Shortest	8 days
Average	4.9 months

X-ray and Radium. The combination of x-ray and radium in tandem at the site of the lesion is the method in use at the University Hospitals in most cases at the present time.

One patient is being treated at present and two patients are alive and well 5 months following this combination of treatment. The x-ray therapy is given in daily doses to six portals. At the end of each round of x-ray therapy the radium is given. This is placed at the site of the lesion under fluoroscopic control. In the patients now living, marked reduction was noted in the lesions during the course of treatment and in studies after the completion of treatment only slight narrowing of the esophagus was noted on x-ray examination and no evidence of tumor was demonstrable with

the esophagoscope.

The results in other patients in this group, now all dead, were:

Longest	8 months
Shortest	2 months
Average	4 months

We believe that our results with our present method of treatment are going to be more favorable. We are now using much heavier dosage of x-ray than formerly and the present condition of our living patients having had this method seems to indicate that we can expect better end results. Only time will tell whether or not recurrence will result.

The longest survival so far has been 2 years. It is therefore evident that any risk is worth taking if the method offers a slight hope of success and surgery may occasionally be successful. Most lesions are however inoperable. Radiation has given many of the patients a few months of improvement and relief. The method of application has been changed gradually and the total dosage increased. The preliminary results indicate that with the present method more encouraging results may be expected.

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VI. GOSSIP

It was the open road last week with four meetings devoted to four separate community enterprises. The first has to do with present day interest in cancer. It is sponsored by the Medical Auxiliary of one of the component societies of the Minnesota State Medical Association. The good ladies have invited members of other organizations in the community and are providing a program of music, talk and food. The music is unusually good. In this case, it is a group from the high school chorus and another group from the band. A young man from the community sings several sentimental ballads including one which was composed especially for his young sister on her birthday. I hold forth on the subject of "Cancer in Women" and tell of the job that is being done in Philadelphia by a group of 500 women who are having pelvic examinations every six months under the leadership of Catharine MacFarlane. The purpose of the present day cancer movement is to talk about the disease and to have other people do likewise. More important is to make constructive efforts to discover the disease early and to secure adequate treatment. The two types of leadership are politely classified as "inspirational" and "constructive." Most of our health movements are long on the first and short on the last. The tea is always arranged with a competitive eye. Late in the afternoon the ladies quickly disperse to repair to their respective homes to await the coming of their lords and masters. Adult education leaders insist that we who speak tend to monopolize too much of the time. They suggest that we start the group talking. A few will ask questions but others can be made to participate by asking them to mention certain phases of the subject which they have found of special interest. Another Ladies' Auxiliary program -- this time in one of our largest cities. The meeting is featured by the distinctive title of "Reciprocity Tea." It would seem as if the doctors' wives are anxious to be invited back, but actually they wish to show their appreciation for favors rendered. Representatives from every organization in the City are present. The musical numbers are replaced by dramatic readings. The speech is about "middle age" and the tea is, as usual, quite an eye-ful. Again the ladies disperse and go to the well-known abode-- The next meeting is a case finding project in tuberculosis. The physicians and representative leaders from the community are present. The city speakers arrive by car slightly behind schedule. When more than one person is involved on a trip, there is always some cause for delay. County people, as a rule, do not wait very long after meal time before they sit down to the table. Except for church suppers obviously put on for profit, country hotel meeting dinners are gigantic portions. One by one the speakers rise in their place and tell the story of great public health conquests including the one which is about to begin. After much discussion, the meeting breaks up with the hope that the realization of the plan has been advanced....The last meeting has to do with a general community effort which has not yet crystallized. It is the second year of a business men's club which is having a difficult time keeping its membership intact. Many of the old time business men are accustomed to going home for dinner at noon. They cannot see why they should waste money buying a meal at the hotel. The organization is the usual mixture of young men, mostly college trained, very often representing chain organizations (banks, oil companies, and so forth). The others are the local community business men who find it difficult to change their habits. Near the head table are female twins, dressed alike, with identical mannerisms and reactions. The husband of one is an official in the community. As little girls, their mother dressed them the same. As ladies, they have continued the custom. Rumor has it they are in their late 60's. The bride and groom are also present and must undergo a great deal of kidding. There is the usual craning of necks and frantic beckoning as "doc" gets his call. The hotel dining room is jammed for this is Ladies' Night, and the room is not very large. An appeal is made to the group to understand their problems and work together. The herd instinct, which seems to be becoming more pronounced, undoubtedly derives impetus from our disturbed national mental hygiene. Through action, most of us find relief for our feelings.....