

## RADIATION IN THE TREATMENT OF BENIGN DISEASES OF THE FEMALE PELVIS\*

G. E. RICHARDS, M.B.

*Chief of Department of Radiology, Toronto General Hospital*

*Associate in Radiology, University of Toronto*

VERY early in the use of x-rays as a therapeutic agent the influence which these rays may exert upon the ovary was recognized, and since those early experiments much additional information has become available, and many controversial points have been cleared up. There still remain a few of the latter, but in general the physiological effect of x-rays and radium upon ovarian tissue is fairly well understood.

*Effect upon the ovary.*—The most sensitive tissue in the ovary, and indeed, probably in the human body, is the mature or maturing ovum and Graafian follicle. Exposure of such tissue to either form of radiation will produce damage to the ovum ranging all the way from temporary devitalization to complete destruction of the ovum. If we accept the standard of dose-measurement now in use, the skin "erythema," it is found that the ovary is from three to five times more sensitive than other tissues of the body, and the amount of radiation required to completely abolish its function is about forty per cent of a unit skin dose. A somewhat smaller dose than this would in all probability destroy all of the fully mature Graafian follicles with their ova, but there would still remain primordial or immature follicles in the ovarian substance which would not be destroyed nor materially devitalized. In a period of months or even of years these would develop, and in their turn become perfectly healthy and fully matured ova.

By a properly arranged system of dosage, therefore, we should, theoretically, be able to affect ovulation by destroying only the superficial layer of fully matured ova, and thus cause the patient either to miss a few periods or to have a diminished menstrual function for a time; or, secondly it should be possible by a

further extension of the dosage factor to influence deeper layers of the ovarian tissue, thus causing cessation of ovulation for a longer period of time; or, finally by a full exposure of the whole ovarian tissue it should be possible to completely and permanently destroy all the primordial follicles in the ovary, and hence bring about permanent amenorrhœa. As a matter of experience all of these theoretical considerations may be fulfilled, and upon this fact much of the usefulness of these methods depends.

*Effect upon the uterine tissue.*—It is probable that upon perfectly normal uterine tissue there is very little effect from radiation either from x-rays or radium. But one of the best known properties of both of these agents is their depressing effect upon cells when in a state of activity or hyperplasia, and the frequency with which this condition in some form or other is met with in the uterus offers a field of wide application for both. Thus, in hyperplasia of the endometrium radium is of value though there are several methods which are probably preferable to it; in hyper-function of the glands of the cervix (leucorrhœa) radium again offers an agent which will destroy these glands and cure the condition in a majority of cases; in fibroids as will presently be shown the effect upon the proliferating cells can be little short of spectacular.

*PART I.—Bleeding in Young Women.*—Reference is here made to simple excessive menstruation in the absence of any organic disease and usually occurring in young women or girls. It is not within the scope of this paper to attempt any discussion of the aetiology of this condition; its relation to disturbances of the endocrine system; nor its treatment by any other method than radiation. The type of case usually referred to the radiologist has already received a fairly prolonged course of such treat-

\*This is the first paper of a series on the "Influence of Radiation in the Treatment of Disease."



ment, and is of such a nature that additional help is required. This is available in two different forms; viz: radiation of the pelvic organs direct and, secondly, radiation of other organs.

Several writers have drawn attention to the very decided possibilities in the latter procedure, and unless the patient's condition is such that no time can be lost, we believe the method of choice is to apply the treatment first to the thyroid gland and over the spleen before subjecting the ovaries to any radiation. By this method a few cases will be brought under control, and a normal menstrual function established. In the only cases in which we have personal experience, the treatment required to be repeated many times, and the percentage of successes was much smaller than in the older method. Aikins has reported favourable results from radiation by radium over the spleen in these cases. Benefit would probably be greater if the thyroid were radiated by x-rays at the same time as the spleen is being radiated by radium, and this procedure is at present being tried out. No reports are available over a sufficient period.

If the above method fails or is not sufficiently successful we proceed to apply the treatment over the ovaries and uterus directly. To ensure a successful result one should explain to the patient exactly what is being attempted since her co-operation is essential.

It is most desirable that the treatment be administered immediately following a menstrual period, but if no definite period can be established one may safely disregard this rule, and proceed as follows: First treatment.—The lower abdomen is marked off into two areas bounded above by a line joining the crests of the ilia, below and to the outer side by the curving line of Poupart's ligament and joining each other at the mid-line of the body. Over each of these areas an x-ray exposure is given which is estimated to be (or, preferably, known to be by accurate measurement) 10 per cent of a skin erythema dose (at the ovary). It is our practice in these cases to use the so-called modified voltage method as distinct from the high voltage. Under these conditions it has been found satisfactory and safe to use the following factors: Spark gap, 7 inches; milliamperes, 5; filters, 3 mm. aluminum, time .5 mins.; distance, 10 inches. At the first sitting

this treatment is applied to each of the areas described above. The patient is instructed to report back immediately after the next menstrual period. If, (as will probably be the case), there has been no material improvement in the amount of bleeding we administer the second treatment. This differs from the first in that at this time the ovaries are both carefully protected, and a beam of x-rays is accurately directed upon the uterus *only* through a central area two inches wide by four inches in length. The actual dose is the same as before.

In this manner exposures are directed alternately upon the ovaries and uterus after each period. As a rule after the second or third treatment the excessive flowing will be materially diminished, and as soon as this occurs the treatment should be discontinued for a time. Very carefully it may then be repeated until the function is normal.

By this method we have succeeded in restoring a practically normal function in over twenty cases. The treatment has been applied in several patients in whom one ovary had been removed, and with no undesirable result to the remaining ovary. Other cases have been treated in whom the results have been somewhat disappointing, and in at least two cases in older women an amenorrhœa was produced which has remained permanent up to the present. This possibility constitutes the only danger, and in women over thirty is a very real consideration. Under that age the risk rapidly diminishes, and with careful technique, if the treatments are not repeated too often, even if an amenorrhœa is produced, it will probably be temporary.

In suitable cases the above procedure provides an excellent means of controlling this very difficult condition. It is, we believe, superior to radium in that it can be very easily done, without hospitalization, anæsthetic, or instrumentation. In girls and young women it is almost entirely safe in the dosage given above. After thirty the danger is greater, and greater care should be exercised. Here it may be well to administer treatment only after each alternate period, but by a suitable modification the method may be made applicable to almost any type of case coming within this grouping.

PART II. — *Menorrhagia: Fibrosis Uteri.* —



For sake of brevity we include under a common head all cases of excessive bleeding in women at or near the menopause (in the absence of a neoplasm).

Many articles have been written upon this subject during the past ten years or more, and yet there still seem to be those who doubt the value of the procedure, or who regard it as being still in the experimental stage. The fact cannot be too strongly stated, that there is probably no therapeutic procedure which is so certain in its effects, and so satisfactory in the vast majority of cases, as the use of x-rays or radium in this type of disturbance of the menstrual function.

It is not necessary to recall to the mind of the average medical practitioner the disastrous effect of prolonged, excessive bleeding upon the health of a woman at this time of life. When this loss continues, as in the past it has often done, for several years the patient is exsanguinated, anæmic, completely exhausted in her physical health, and frequently in her nervous and mental health as well. Curetting the uterus has been repeated on such patients several times with but temporary relief, and in many hysterectomy is at last resorted to as the only sure means of controlling the hæmorrhage. Under such circumstances the mortality rate following such an operation is necessarily high.

With the means now at our disposal all of this is entirely unnecessary, and we fail to see any reason why a woman should be permitted to bleed herself into a state of chronic invalidism from which she can only recover over a period of years; if, indeed, she ever does recover.

All rational therapy should rest upon a basis of accurate diagnosis, and in this instance it is exceedingly important that this be done. Cleland states that in the last one hundred cases he has found carcinoma five times by microscopic examination of the scrapings from the uterus, in cases in which there was no clinical evidence to suggest the presence of such a condition. This figure seems high, but nevertheless a preliminary curettage should be done as a matter of precaution, unless there is some definite contra-indication to this procedure.

If it can be positively established that no latent infection is present in the pelvis, radium may then be inserted at the same operation,

but if there is the slightest suspicion of infection in the pelvic organs (pus tubes past or present, old healed pelvic cellulitis, etc.) the use of radium is absolutely contra-indicated, and such a patient should be treated by carefully administered x-rays according to the modified voltage technique.

If radium is used in these cases it should be administered within the uterine cavity. The dose recommended is now fairly well standardized, and consists of a fifty milligram silver tube within a brass tube having a wall thickness of two millimeters, and this in turn enclosed in a pure gum rubber container also of two millimeters wall thickness. Such an applicator is left in situ for a period sufficient to deliver an average dose of fifteen hundred milligram hours, slight modifications being made in the individual case as may be deemed advisable.

The same result may be obtained by the use of x-rays, and in this case the whole procedure is rather more simple. As a rule the patient referred for x-ray treatment has already had a curettage, and this is, therefore, unnecessary before commencing treatment. The curettage having failed to control the bleeding, it is now desired to do so by means of x-ray exposure.

The administration differs only in detail from that outlined in the treatment of bleeding in young women. In the present instance it is our practice to administer two anterior and two posterior areas, concentrating the beam of rays upon the uterus and ovaries and administering an exposure as follows: Spark gap, 9 inches; miliamperes, 5; filters, 6 mm. aluminum, time 15 minutes; distance, 10 inches. This dose is given preferably immediately after a period of bleeding, one area being given each day until the four have been completed (two a day may be given if desired, or indeed the entire series at one sitting), and this is then repeated after the next succeeding period. A third may be necessary and is advisable if one wishes to make absolutely certain of obtaining the permanent cessation of the function.

In the presence of suspected infection this dose is too severe, and might be dangerous. Under these conditions recourse should be had to the method outlined in the first part of this paper. Such a dose has been used very successfully by us in a number of cases for the



control of acute and chronic salpingitis, and has never to my knowledge caused an acute exacerbation of pelvic infection. We believe it can be used safely and by repeating it more often the same end-result may be obtained.

In the same manner by using higher voltages and heavier doses, the whole result may be brought about at a single treatment in a manner comparable to the use of radium. We have preferred the first method described as against either radium or the intensive x-ray method, because it more nearly approximates the natural cessation of the menstrual function, taking place over a period of months rather than within a few days or weeks. It has seemed also that the undesirable features of the menopause have been less marked under these conditions.

*Results.*—We have records of the treatment of 148 such cases as outlined above using some one or other of the various methods mentioned. In no case of which we have knowledge has the treatment failed to control the hæmorrhage. There has been no mortality. The average number of treatments necessary have been two (series) with no hospital expense, no anæsthetic, and none of the other additional expenses incidental to operative procedures. It has been our object throughout to produce the desired result with the minimum of radiation, with the consequence that in a few cases in which only two series of treatments were given slight bleeding has returned later. This could, of course, be prevented by invariably giving an additional exposure (which, however, would be unnecessary to the vast majority and therefore undesirable). Such an occurrence is not in any sense a failure in the treatment.

*PART III.—Radiation treatment of Fibroid Tumours.*—(a) In young women.—Owing to the possibility of damage to the ovary with its contents, it is highly desirable that the radiation treatment of fibroid tumours during the child-bearing period be reduced to the minimum, and if undertaken at all, only by those with much experience in this field. In all cases in which simple myomectomy is possible, it is probable that this is the method of choice. But an occasional case will be presented in whom for some reason operation is not possible. Experience has amply shown that it is quite possible to shield off the ovaries, concentrate the x-ray

beam upon the uterus only, and cause the complete disappearance of such tumours without harm to the ovary or any material interference with menstruation. Several cases are now on record in whom subsequent pregnancy has occurred with normal living children at full term.

(b).—Fibroids complicating pregnancy.—For many years the statement has been made and has found its way into a few text books that x-ray treatment of fibroid during pregnancy was wrong, and likely to be followed by disastrous consequences. While the number of cases of which we have personal experience is too small to make any general denial of such a statement, yet, we believe these will show that under properly controlled conditions such treatment may be carried out with entire safety and results of very great practical value. Three cases are reported.

*Case 1.*—Referred by Dr. Gordon Copeland, and reported fully by him elsewhere.

This patient was referred during the fourth month of pregnancy, having a cervical fibroid of some size undergoing progressive enlargement. It was so situated as to constitute a definite obstruction to labour, and from its pressure was causing pain. Two comparatively light exposures caused the prompt and complete disappearance of this tumour. In the treatment the uterus and other pelvic organs were carefully screened off, and only the cervical region with the fibroid treated. The patient went to full term, labour was uncomplicated and uneventful, but the child born proved to be a monstrosity (Siamese twins). It is agreed by all who have studied this case that x-ray treatment could have had no part in the causation of such a monstrosity. At the period at which the treatment was administered, the conformation of the foetal body would be fully determined.

Following delivery normal menstruation was resumed in due time, and has continued since. There was, therefore, no damage to ovarian tissue by reason of the radiation.

*Cases 2 and 3.*—Referred by Dr. Van Wyck, and reported fully elsewhere by him.

In both of these patients, fibroids were known to be present prior to conception, in both they increased in size after conception, and in both the deciding factor in under-



taking treatment was pain. This pain was described as being so severe as to be almost unbearable, and was becoming progressively worse.

One patient presented a feature of unusual interest in that her sister had also suffered from a similar complication of pregnancy (by fibroids), and had died following an operation for their removal. The patient, therefore, was opposed to surgical intervention, and quite willing to try any method which seemed to offer a solution of her trouble.

Both patients were treated at about the same stage of pregnancy (four months) and in very much the same manner. The relief of pain was spectacular, and began within twenty-four hours following the administration of the treatment. Within three weeks the tumours were completely gone in both cases, and no further treatment was necessary. Both went to full term, and were delivered of perfectly healthy children.

The outstanding feature of all three of these cases has been the small amount of radiation required to secure complete recession of the tumours. The treatment was slightly modified in each in order to best adapt it to the particular location of the tumour, but the amount of actual radiation would correspond to a single area over the tumour consisting of a ten-minute exposure, all other factors remaining the same as already detailed earlier in this paper.

There is, therefore, no doubt that such treatment may be given quite safely, and that a small amount of radiation may be sufficient to produce a satisfactory result. Such being the case there is no need to administer very heavy or intensive doses by high voltage methods or by radium, and this is the type of radiation which might be expected to cause damage to the developing foetus. We have accordingly reached the conclusion tentatively, that in all future cases we shall advise a preliminary radiation along the lines described above before undertaking any more radical procedure either surgical or by heavier doses of either x-rays or radium. It cannot be denied that the use of intensive treatment especially of the high voltage type might be attended by unfortunate or disastrous consequences. But the amount of available exact information on this subject

is so small as to make it difficult to reach a satisfactory opinion.

Diressen (Leiden) has collected nearly twenty cases since 1914 in which women were exposed during pregnancy to the Roentgen rays, and reports that the foetus was injured or destroyed in half the cases. This injury he states to be more probable in the earlier stage of the pregnancy, and affects the nervous and vascular systems and the special senses, especially the eye. He makes no statement in this article of the amount of radiation applied in any of the cases reported or for what purpose the treatment was administered, and concludes by stating that thus far no injury has resulted from the use of x-rays for the making of Roentgenograms, but thinks this may be a possible source of danger as well.

At the present time the x-ray is being used freely in this country as an aid in diagnosis during pregnancy, and if this use of the rays were attended by any undesirable consequence it would seem that this fact would be amply evident. As a matter of fact we have failed to find any authenticated case reported, and think the danger from this source must be negligible when compared to the importance of the information made available by its use.

(c) Uncomplicated fibroids.—Whether in a given case a fibroid should be treated (or removed by any other means) is outside the scope of this paper to discuss. No doubt many fibroids do not require treatment of any kind. But having decided that some method of dealing with the problem is advisable it is essential to establish certain facts as accurately as possible.

- 1.—That the tumour under consideration is actually a fibroid and not a cyst (which would be uninfluenced by radiation).
- 2.—That the fibroid is not pedunculated (or has not a narrow pedicle at least).
- 3.—That there is no infection in the pelvis.
- 4.—The size of the tumour and as far as possible its point of origin (subserous, intra-mural or submucous).

These are the factors of greatest importance, and from a knowledge of them the probable effect of treatment may, we believe, be fairly accurately predicted.

Infection of any sort in the pelvis is a funda-



mental contra-indication to the use of radium or intensive x-ray in any of these conditions. A pedunculated fibroid having a narrow pedicle must be treated, if at all, with the greatest care. A broad pedicle we have found to give no trouble whatever, and do not consider it a matter of importance. Submucous fibroids we believe are better treated surgically, but if this is not done radium is preferable to x-rays. Thus we return to the title of this section, viz., "Uncomplicated fibroids," which constitute the legitimate field for this form of therapy.

Results of treatment: Fibroids up to the size of a four months' pregnancy are treated equally well by either radium or x-ray, and in each the percentage of cures is almost 100 per cent. Some writers report from one to two per cent failures in nearly all of which some complicating factor was present. There is no doubt, however, that this treatment is successful in a very uniform manner. We have treated eighty-six such cases and in these there has been no case in which the tumour has not disappeared entirely.

In those cases in which the tumour extends half way up to the umbilicus, the field in which radium is of value gradually diminishes, and in these larger fibroids it is our strong conviction that x-rays are more effective. The possibility of a complete disappearance of the tumour is lessened and the length of time over which treatment will be necessary is correspondingly increased. In this group the percentage of successful results still remains sufficiently high to make the procedure a very efficient method. Even in those few cases in which the tumour does not disappear entirely it is reduced to such an extent that it can be

recognized with difficulty, and usually gives no symptoms. Such a result may, we believe, properly be regarded as a cure.

Massive fibroids reaching well up to or beyond the umbilicus are of such a nature that it would be idle to expect their disappearance by such a method. And it is in a graded group of cases from the preceding, all the way up to the more extreme examples of the present group that the failures recorded against the radiation method of treatment largely lie. If a good record in the matter were the only consideration, it could be established by declining to treat these cases. But much may be accomplished even in these.

We invariably advise that surgical treatment of this type of case is the method of first choice, and if for any reason this is not desirable, or if the patient declines operation, then radiation may be expected to reduce the tumour, but not to cause its disappearance. The amount of reduction which may take place is surprising, and in many cases has been sufficient to render the patient comfortable.

*Multiple Fibroids.*—In our own experience the greatest number of failures has been in the group of large multiple fibroids, and in these we have seldom seen complete disappearance of the tumours. Since these are the cases in which malignant degeneration is most likely to take place, we place them in the same category as the very large massive fibroids and advise surgical removal. Unless there is some very strong reason against this being done we believe it should be insisted upon, and that such cases should only be treated by radiation in case operative interference is definitely contra-indicated.