With the closed method less ether is required per case, since to a very great extent it is retained within the system, where it quickly becomes warmed. The use of the throat tube, while making the system workable, assures a clear and adequate airway in any position in which the patient may be placed, and also prevents saliva and other matter from reaching the lower air passages. The anaesthesia is conspicuously dry, even where atropine has been omitted and saliva has flowed profusely. The use of the tube extends the scope of surgery to the head and face, including the teeth.

The apparatus used is compact and light, easily handled, and simply constructed. There are no fine adjustments to become deranged. The working costs are the lowest possible, as consumption of anaesthetic gas is independent

of the duration of the anaesthesia, being estimated at so much per case. Where working costs have to be considered, as in most hospitals, the recovery principle provides the usual gas-oxygen anaesthesia for less than the cost of open anaesthetics in cases of average duration. The necessary apparatus and supplies are easily portable.

Reviewing the position as it appears to me from a limited experience of this closed system of anaesthesia, I think we have gained access to a new field of anaesthetic administration sighted by others a long time ago. We must now set about its exploration by developing apparatus and technique, and, with the possibility of finding newer and more potent anaesthetic agents, no one can say what further advantages the closed system has to give.

X-RAY TREATMENT OF DISEASES OF THE GENITO-URINARY SYSTEM*

BY

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The x-ray treatment of diseases of the genito-urinary system is a somewhat wide subject, and one that cannot be dealt with adequately in the time at my disposal. It is a little difficult to decide where to begin, but it will be well perhaps, in the first instance, to say a few words about technique.

Unit Skin Dose

There is still a good deal of controversy and confusion as to what is implied by a unit skin dose—a skin erythema dose; the number of r units which represent these doses, etc., so many factors, and the grade of erythema produced varying considerably in different clinics. All this is too controversial to enter into in this short communication; nevertheless, it is advisable for me to give some idea of what I am talking about when I refer to an erythema dose. Personally, I mean a dose which, when applied to the skin of the abdomen of an adult, produces a slight redness within three weeks after the application, followed by some bronzing or pigmentation of the skin, but no desquamation. This is at least 25 per cent. less than that often given and described by many as an erythema dose, and may perhaps be described as the mild or minimal.

After some thirty years' experience, however, I have been much impressed by the importance of preserving the integrity of the skin, and would rather limit the skin dose and increase the number of ports of entry wherever possible than run the risk of causing damage. I am well aware that this is not always possible, and there are cases where the dose mentioned may have to be exceeded, but one must be careful not to produce a cure which is worse than the disease, many such having come under my notice. I know that those who advocate a so-called epidermicidal dose say that complete repair takes place; but is this permanent? I doubt it, as most patients so treated do not live long enough to tell the tale. There may be those here, however, who may be able to show that I am wrong.

The dose I have mentioned, if applied at a single sitting, in a certain time, at a certain distance, and at a certain kilovoltage, is a fairly definite one, and is what is implied when I refer to a unit skin dose in this paper; if spread over several days the total exposure required to produce the same effect will be greater. Levitt has stated that a 100 per cent. dose given in one day if spread over

one week would require 150 per cent., and spread over a fortnight some 220 per cent. to produce the same effect. From my own observations I would say that this is a fairly accurate estimate, and important to remember when mapping out a dose that has to be spread over an interval of time. Different diseases require different techniques in order to obtain the best results, and having decided on what is likely to be the most beneficial dose in a certain case, the next thing to consider is the best way to administer it, and we have various techniques to choose from.

Fractional Dose

This is by far the oldest method, and is still largely used, chiefly in the treatment of benign conditions. It consists in giving fractional doses of one-third to four-fifths or so of the unit skin dose at intervals of a few days, a week, or longer, and kept up, in some cases, for a considerable period of time.

Single Massive Dose

This method created a great stir when it was first introduced into this country, and some very exaggerated claims were made for it, which were not substantiated. Its aim is to apply uniformly throughout a malignant growth the largest dose which the tissues will tolerate, the whole dose being given in one day. I tried the method when it was first introduced, in a few cases of malignant prostate, but very quickly abandoned it on account of the practically constant, and often somewhat alarming, constitutional upset which resulted. It still has certain uses, as in the treatment of rodent ulcer, etc., but not, to my mind, in any disease of the genito-urinary system.

Divided or Split Dose

This is a modification of the preceding method. The dose, instead of being given in one day, is spread over an interval of time, at daily or two-day intervals, according to circumstances; and here it must be remembered, as I have already pointed out, that the actual dose given at each exposure will depend upon the time over which the treatment is to be spread. This is the method I consider to be the most suitable in the majority of cases.

Saturation Method

The saturation method is one I have never used. Its aim is, after a maximum dose has been given, to keep up the effect by giving further daily doses of some 15 per cent. of the unit skin dose for several days.

Protracted Fractional Dose Technique (Coutard)

This method is also one of which I have no personal experience. Malignant genital tumours so treated have been reported by Schumacher, who states that although

* Read in opening a discussion in the Section of Radiology and Electrotherapeutics at the Annual Meeting of the British Medical Association, Bournemouth, 1934.

the bladder and intestine have received as much as 2,000 to 2,500 r when this procedure was applied to the lower pelvis, the reaction of these organs was astonishingly little. Possibly our president, who has had some experience of this method in the treatment of cancer of the larynx, may have used it in some genito-urinary case; if so, his experience and that of anyone here who may have tried it will be very interesting.

Various factors which influence the biological effect of a dose of x rays, such as the time taken, the interval between the doses, the quality of ray, etc., are still very controversial, and cannot be entered into in any detail. Generally speaking, it seems to be assumed by most radiologists at the present time that, in the treatment of malignant cases at any rate, the hardest rays possible should be employed—180 kV upwards—and the object aimed at should be to give uniformly throughout a tumour 100 per cent. of the unit skin dose without damage to the surrounding tissues. This, of course, in many situations is extremely difficult, but were it always possible I, personally, doubt if we should find that a cure could be effected—there are so many factors of which, as yet, we know nothing. I could quote quite a large number of cases of breast carcinoma in the early days of x -ray treatment, when a gas tube and 12-inch or 16-inch spark-coil were used, in which recurrences in the region of the scar completely cleared up. Needless to say, the kilovoltage here was nothing like 180; the lesions, true, were superficial, but they disappeared under this type of radiation. I am not one of those who hold that low kilovoltages should be employed in the treatment of malignant disease. Far from it, for various reasons; but I must say that I doubt whether the quality of the ray from high kilovoltage machines is as important as the fact that with such we are able to give a more uniform depth dose.

Another curious fact I have observed on several occasions may be exemplified by quoting two similar cases of bone metastases which came under my care at the same time. In the one the lesion was attacked by giving a unit skin dose through several ports of entry in an attempt to deliver as large a dose as possible; there was no good result—in fact, rather the opposite. In the other, only one erythema dose on the skin over the lesion was given, and the condition completely cleared up, as evidenced by x -ray examinations carried out before and after treatment. How are we to account for this if a 100 per cent. dose is necessary in all cases? And are we not inclined, in these days, to be too mathematical in our dosage, forgetting that the human body is a very variable factor, and that one man's food may be another man's poison? As you know, large doses of x rays are destructive and have an injurious effect upon the patient, the body being able to tolerate only a certain amount of what, for want of a better name, we may call the x -ray poison; small doses, however, have a stimulating effect, as I shall show later. There is one thing I am certain of, and that is that whenever large doses are considered to be necessary they should be so regulated as to avoid, as far as possible, any lowering of the general resistance of the patient, since there is no doubt that many who have received too big a dose go downhill rapidly. Therefore, the ports of entry should be as small as is compatible with efficient radiation; the shortest route to the lesion should be chosen; the patient should be protected from scattered radiation; and if on a trial dose there is any upset, the intervals between the doses should be increased from one to two, three, or more days, regulating the dose accordingly, rather than risk this lowering of vitality. It should never be forgotten, as Dr. Gilbert Scott has humorously remarked, that there is a patient attached to the tumour!

Diseases Treated by X Rays

So much, then, for a short survey of general principles. We will now go on to consider the various diseases treated by x -ray therapy, and, in the first place, the kidneys. These organs, situated as they are in the upper abdomen in close relation to the liver, spleen, suprarenal capsules, and large and small intestine, present considerable difficulties, and quite often severe constitutional disturbances are encountered. On this account no attempt should ever be made to give a single massive dose, and the effect of divided ones must be carefully watched, since practically the only conditions radiologists are called upon to treat are growths. There is no doubt that the advance of pyelography and excretion urography has enabled the diagnosis to be made much earlier, such growths as hypernephromata giving a characteristic picture. If an early diagnosis is made x -ray treatment should never be recommended, barring some contraindication, in place of operation; but in advanced inoperable cases such treatment is to be recommended, for although, so far as I am aware, no cure has been reported, there have been cases where a marked reduction in the size of the growth has taken place and been maintained for some considerable time.

Growths of the Bladder

Here again operation is the procedure of choice. The only cases that have come under my care are those where diathermy or operation has failed, or where the growth is considered for some reason or other to be inoperable, and I must say that x -ray treatment in such cases has proved most disappointing. From the experiences published by Sir John Thomson-Walker it would appear that pre-operative radiotherapy, with the idea of reducing the size of the growth, is not to be recommended, as the bladder becomes spasmodic and contracted, and the limits of the growth difficult to define. Neither is immediate post-operative treatment to be recommended when there is an open wound, on account of the risk, a very great one, of increasing urinary infection. In the case of growths unsuitable for operation, or in recurrent growths, x -ray treatment should be tried; and a few good results have been reported, though, as I have said, they are as a rule very disappointing. The split dose method is the one to employ, and the effect of each exposure must be carefully watched; it is advisable, to my mind, to spread the dose over a period of ten days or a fortnight.

Simple Enlargement and Malignant Growths of the Prostate

In my experience simple enlargement of the prostate is very favourably influenced by x -ray treatment, but the results cannot be said to be certain or constant. In view of the fact that in skilled hands the modern operation for enlarged prostate is so successful, I would say that radiotherapy should not be recommended as against operation, unless there is some definite contraindication. Nevertheless, I know of several medical men who, when their own prostate becomes enlarged, preferred to try x -ray therapy rather than submit to operation, and in some cases the results have been most encouraging. One has to remember in these cases that, although the growth is non-malignant, quite a large dose is necessary, in the region of 90 per cent. of the erythema, if the best results are to be obtained. All my cases have been treated through six ports of entry—three anterior and three posterior.

In the case of the malignant prostate the operation is a very severe one, and the results not very encouraging, and in such cases x -ray treatment may be said to compete with surgery. The most usual result of such treatment is, I fear, a temporary improvement with some diminution in size and often reduction of the hardness.

The latter, however, is not permanent; a relapse usually takes place quite early, but occasionally not for a year or two, or even longer; five years is the longest in my own series. At times, however, one gets a case where the growth appears to disappear completely. In such cases the question of incorrect diagnosis always crops up, but even if the growths are non-malignant, which I doubt, then we have some further proof of the good results in simple enlargement, and the existence of such cases gives us ground for hope that with some modification in technique we may find a means of making our numerous temporary improvements permanent.

The bulk of the cases of malignant prostate which have come under my care have been treated by the six field method, sometimes supplemented by a perineal field, the dose being the erythema described on the skin of each area: size of ports, 6×8 cm.; distance, 30 cm.; kilovoltage, 180; filter, $1/2$ mm. zinc or copper + 2 mm. aluminium—the dose being spread over ten days to a fortnight according to circumstances.

In all cases of prostatic enlargement, and the same applies to bladder growths, great care must be taken to reduce urinary infection to a minimum, and if this cannot be done I would say that x -ray treatment is contraindicated. There is no doubt that urinary infection is accelerated by x -ray exposures, and in not a few cases a general urinary infection following x -ray treatment has been the cause of death. The dose I have mentioned may be repeated after an interval of from six weeks to two months, preferably the latter. It must be pointed out, however, that reaction is generally more marked when a further series of doses is given; therefore the doses should be somewhat reduced and the results carefully watched. All patients should be kept in a nursing home or under medical supervision while the treatment is being carried out, so that any emergency arising from reaction, such as retention of urine, may be promptly dealt with.

Growths of the Testicle

Although some of these are quite radio-sensitive, they should, in my opinion be removed surgically, and x -ray treatment to the glands should follow. The results of such treatment are quite encouraging, and I know of one case where the glands were very definitely enlarged. This was many years ago, and the patient is still perfectly well.

Tuberculous Epididymitis

This condition responds very favourably to quite small doses of x rays, and one patient, treated in 1932, appears to be completely cured after four doses only of $1/2$ B.S.N., 120 kV, 1 mm. aluminium filter, ten days interval between the first and second doses, and three weeks between the third and fourth.

Carcinoma of the Cervix

We will now go on to consider the x -ray treatment of diseases of the female genital organs, and take malignant conditions first. Of these carcinoma of the cervix is by far the most common, and is undoubtedly favourably influenced by x -ray treatment. In quite a fair proportion of cases the disease appears to clear up completely, but here again a recurrence sooner or later, which is much more resistant to radiation treatment, is the rule rather than the exception, though one does occasionally see patients who remain in good health for years after x -ray treatment alone.

A good deal of controversy still exists as to the best form of treatment. There are those who hold that in suitable cases operation in the hands of a skilled surgeon is the procedure of choice; others hold that radium is superior to x -ray therapy; while others hold that a combination of x -ray therapy and radium affords the best

hope of success. At the moment I am against radiation treatment in any malignant condition where an operation can be efficiently carried out, but in cases where, for some reason or another, operation is contraindicated I would say that the combined x -ray and radium treatment offers a better prospect than either given alone. Most frequently at my own hospital radium has been applied in the first instance, and after a suitable interval the patient is sent down for x -ray therapy. I am of opinion that this order should be reversed, radium being applied some six weeks to two months after a thorough irradiation by x rays. I feel that such a procedure would reduce the number of cases in which a recurrence takes place after x -ray treatment alone.

Carcinoma of the Body of the Uterus

On the whole this condition is less favourably influenced by radiation treatment than cervix cases, though quite a number respond quite well. Failing operation for choice I consider that x -ray treatment is superior to radium, and the same applies to sarcoma. The divided dose technique is the best procedure to adopt, though I believe in cervix cases some radiologists still employ the single massive dose as originally worked out at Erlangen.

In the case of the ovary the type of growth met with is very variable, and some growths are undoubtedly radio-sensitive. Nevertheless, if the case is operable I would strongly advise surgical removal, followed by a course of x -ray therapy. In all inoperable cases x -ray treatment is indicated, and, in a few, very remarkable results have been obtained, the patients remaining well many years after. This, however, is the exception rather than the rule, and no doubt the results depend largely on the type of malignancy. It is advisable in all these cases to irradiate the whole pelvis by the divided dose technique.

Non-Malignant Conditions

We now come to certain non-malignant conditions, such as menorrhagias of the menopause, menorrhagias at other periods with no definite pathological condition of the uterus, menorrhagias associated with fibroids, and cases where, owing to dysmenorrhoea or other conditions, sterilization is considered advisable. I have put all these cases together, as the dose in each is practically the same, and may perhaps be called the sterilization dose; it is about 35 per cent. of the erythema dose to each ovary. In this class of case x -ray treatment is, in my experience, most successful, and if we omit certain cases of fibroids we may claim almost 100 per cent. of cures without any undue upset.

Personally, I give a rather larger dose than that mentioned—namely, 40 per cent. through four ports of entry, one anterior and one posterior over each ovary. In very obese subjects this has, at times, been supplemented by a postero-lateral field in each side. Since, with efficient apparatus, one-third (or even more) of the dose applied to the skin reaches the ovary, it is evident that these results can be obtained without producing any skin reaction. There are two ways of carrying out this treatment: the total dose may be given at one sitting, in which case it is advisable for the patient to go into a home or to remain in bed for two or three days, or the dose may be reduced to some 25 per cent. and spread over three months at monthly intervals. This causes practically no upset whatever, and the results are excellent in both cases.

I would like to emphasize the importance of having every case thoroughly examined by a gynaecologist before commencing the treatment, and I make it a rule never to undertake a case that has not been so examined, for obvious reasons. As I stated early in this paper, small doses of x rays are stimulating, and this fact may be

made use of in the treatment of cases of sterility with ovarian hypoplasia, in amenorrhoea, and other minor menstrual disturbances. In a series of cases treated at St. Mary's Hospital and elsewhere the procedure has been to give one-tenth of the erythema dose to the skin over each ovary through an anterior port at intervals of one month, and repeated three or at the most four times. The treatment can do no harm, and has proved successful, so far as I can judge at the moment, in a little under 25 per cent. of cases; it is therefore well worth trying. I shall be very interested to hear if anyone present has tried the treatment, and with what results.

There is another minor, but sometimes most distressing, complaint, which frequently responds very favourably to small doses of x rays, and that is pruritus vulvae. A large number of patients get relief, and not a few are cured, but some, for reasons unknown, do not respond at all. My practice has been to give $1/2$ B.S.N., $1/2$ to 1 mm. aluminium filter, 120 kV, once a week for three doses, followed by a further dose of $4/5$ B.S.N. through 3 mm. aluminium some three weeks later. This latter dose I have used also in cases of leucoplakia, but the results, on the whole, have not been very encouraging. Cases of carcinoma of the vulvae referred for radiation treatment are best treated, I think, by radium, followed by a thorough irradiation by x rays of the inguinal glands.

I realize that this communication is incomplete, and deals with the subject in a somewhat scrappy manner, but I hope some points have been raised which will lead to discussion.

THE DIAGNOSIS OF INTRACRANIAL TUMOUR*

BY

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There is no doubt that many members of the medical profession still consider cerebral tumour to be a rare disease which hardly ever occurs in the ordinary run of general practice, and that its manifestations are obscure and unlikely to be recognized. In fact, however, cerebral tumour is rather common, and gives rise to signs and symptoms which are often easy of interpretation. Although the exact localization of the tumour within the brain may be a matter of considerable difficulty, and indeed it may be impossible, the fact that the cranium does contain a tumour can often be diagnosed at an early stage.

Frequency of Cerebral Tumours

It is always difficult to arrive at a figure which expresses with any accuracy the incidence of a disease in the general population, as there are always so many variable factors which affect such a figure; but in conjunction with Mr. Armitage I have made an attempt to reach some conclusion as to the frequency of cerebral tumour, though these figures are still admittedly open to criticism. We have analysed the records of 13,000 necropsies performed at the General Infirmary at Leeds during the last twenty years, and this series consists of cases of all possible types. We have published a detailed analysis elsewhere,¹ but we were able to draw the following conclusions. There were 3,533 cases in which the brain had been examined (27 per cent.), and of these 264 contained a tumour. Now the brain is examined in any patient who showed cerebral symptoms during life, so that most of the cerebral tumours must have

been discovered; on the other hand, a certain number of symptomless tumours may have been missed. The percentage of brains examined which contained a tumour is 7.45 and the incidence of cerebral tumour in the whole series of 13,000 cases is 2.02 per cent. These figures relate to pathological masses within the skull, and of course a number of these were tuberculomata; the incidence of actual neoplasms is 1.34 per cent. Table I shows the number of cases of cerebral tumour compared with the incidence of other common lesions of the nervous system in the 3,533 cases examined.

TABLE I

Disease Condition	Number of Cases
Purulent meningitis	373
Tuberculous meningitis	356
Cerebral tumour	264
Cerebral haemorrhage	211
Cerebral abscess	165

For the figures contained in Table II I am indebted to Dr. Georgiana Bonser; they are taken from the same series of necropsies. In this table the number of cases of cerebral tumour is compared with the number of cases of other common tumours.

TABLE II

Cancer of colon	26 per cent.
Cancer of stomach	2.5 "
Cancer of lung	1.2 "
Cerebral tumour	2.0 "
Cerebral neoplasm	1.3 "

The conclusion one can draw from this table is that a mass inside the skull is almost as common in the post-mortem room as a cancer of the stomach or of the colon, and that 66 per cent. of these are true neoplasms. These figures, then, give some idea as to the frequency of cerebral tumour, and it is interesting to compare them with some clinical figures from the National Hospital, Queen Square, published by Walshe⁴: of 1,309 cases admitted in one year cerebral tumour heads the list of classified diseases with 163 examples, disseminated sclerosis being second with 133, and neurosyphilis, of all forms, third with 113.

The third table shows the relative frequency of the different pathological types of tumour compared with similar figures quoted by Walshe,⁴ which refer to cases operated on at the National Hospital and by Cushing at Boston.

TABLE III

Type	Leeds	London	U.S.A.
Glioma	35.9	40.5	41.5
Metastases	11.3	6.4	4.0
Meningioma	5.6	13.5	12.2
Neurofibroma	1.5	11.5	8.5
Pituitary	3.3	13.1	25.2
Tuberculoma	33.8	2.6	2.8

It will be seen that in all cases the glioma is the commonest type of tumour, but the most striking difference between the lists is with regard to the tuberculoma. The reason for this has been pointed out¹; it is because tuberculoma does not give rise to physical signs until it is complicated by tuberculous meningitis, and for this reason practically never reaches the surgeon's hands. It appears that tuberculoma of the brain cannot

* A lecture delivered to the Halifax Division of the British Medical Association, March 13th, 1934.