ON THE RADICAL ABDOMINAL OPERATION FOR CARCINOMA OF THE CERVIX ("WERTHEIM'S"),

WITH NOTES OF EIGHTEEN CASES, OF WHICH SIXTEEN WERE
TOO ADVANCED FOR VAGINAL HYSTERECTOMY.

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The radical operation for carcinoma of the cervix as devised by Wertheim is being cautiously taken up by certain surgeons in this country, but as yet no single operator here has performed it sufficiently often to speak dogmatically as to its technique, its difficulties, or its merits. In other words, the operation is still on its trial, and it is for this reason that we venture to record the experience that we have gained thus far.

The aim of Wertheim's procedure is to remove the uterus and adnexa, with the diseased cervix enclosed in the upper part of the vagina, across which clamp forceps have been applied so as to prevent the escape of detached carcinoma cells into the normal tissues which have been exposed during the operation, and to excise together with these parts as much of the parametric and paravaginal cellular tissue and as many of the pelvic lymph glands as may be feasible. The technique of the operation has been very fully described by Wertheim himself, and we therefore forbear to redescribe it at length, merely stating that we have in the main followed the lines laid down by him. But we would draw attention to some points in the conduct of the operation which it appears to us might be useful to those who have not yet essayed it.

The Separation of the Bladder.

The successful separation of the bladder from the supra-vaginal cervix and vagina is the first important step in

Fig. 1.—The authors' vaginal clamp forceps for the radical abdominal operation for carcinoma of the cervix.

the operation. It should be effected by rolling back the bladder by digital pressure applied through a swab or pledget of gauze. The unguarded finger or any steel instrument should on no account be used, for fear of perforating the vesical wall. In cases in which the growth has not advanced towards the bladder, this viscus strips backs with ease, but where it has, the separation is a

matter of difficulty and anxiety. This is due not only to morbid adhesion, but also because the carcinomatous hypertrophy of the cervix, by increasing the area of bladder attachment, causes a stretching and thinning of the bladder, so that its wall in this region may be reduced to a thinness rivalling that of a sheet of notepaper. A wound of the bladder in this situation is a serious matter in an operation in which time is of paramount importance, for since it is situated at the junction of the posterior wall and the trigone, its suture becomes a very troublesome matter both on account of its inaccessibility and because of the liability of the sutures to cut through the frail tissue. And, further, owing to the fact that the wound presents without peritoneal support into the large empty subperitoneal cavity that the operation of necessity leaves, and that this cavity invariably becomes more or less infected, the chances of the sutures holding are much reduced. A vesical fistula in this situation is a very troublesome affair, taking a long time to heal, and being very difficult or impossible to close by operation.

The Separation of the Ureters.

We have found that the most convenient method of separating the ureter is to commence its definition by sense of touch as it clings to the peritoneum of the

posterior layer of the broad ligament and lateral pelvic wall, and then to expose it by rough dissection with the blunt points of an ordinary dissecting forceps. The ureter is then isolated by passing an aneurysm needle under and around it just where it enters the parametrium; this picks up not only the vascular periureteral sheath but a small amount of cellular tissue as well, and thus the danger of injuring the sheath itself and causing ureteral necrosis is avoided. The ureter is now, together with its sheath, completely isolated by scissors and blunt dissection down to its

entrance into the bladder, and is held aside whilst the paravaginal tissue deep to the ureter is clamped preparatory to the amputation. Some operators have contented themselves with merely *exposing*, but not *isolating*, the ureters; but unless real isolation is effected it is impossible (1) to remove the paravaginal tissue, and (2) in advanced cases to place the ureter out of harm's way during the amputation. The difficulty of ureteral isolation varies immensely. In early cases it is slight, but where the parametrium is infiltrated it becomes great. We have noted that in these advanced cases the enlargement of the cervix carries the ureter outwards towards the pelvic wall. In these, too, the "ureteric canal" becomes obliterated, and the separation of the uterine artery from the ureter is rendered more troublesome. It is remarkable how very resistant the ureteral sheath is to carcinomatous invasion, even when this structure is surrounded by growth.

The Removal of the Parametric Tissue and Glands.

A varying proportion of the parametric tissue can be removed attached to the amputated uterus and vagina, but we find that the bulk of it is best extirpated after this step has been carried out. This particularly applies to the subureteric mass which runs down the side of the vagina as far as the upper surface of the levator ani muscle. The lymph glands are, of course, removed after the amputation. The path of lymphatic permeation in these cases is very constant, namely, directly outwards to the side wall of

Fig. II.—Case 6.

the pelvis and thence upwards over the brim to the glands along the external iliac artery. The lymphatics from the cervix do not, therefore, follow the course of the uterine vessels, but run more directly outwards. The glands that it is important to remove (whether enlarged or not) are, therefore, those found in the broad ligaments (particularly one often found over the ureter just where the uterine artery crosses it) and along the course of the external iliac arteries. In advanced cases this dissection may be extended up to the bifurcation of the aorta.

The Control of Haemorrhage.

Where the broad ligament is not extensively infiltrated and a ureteric canal is present, the separation and ligation of the uterine artery outside the ureter is not difficult. This artery usually arises somewhat obliquely from a trunk common to it and the superior vesical artery. It is undesirable to ligate this common trunk since by depriving the bladder of a certain amount of blood supply the likelihood of necrosis of it or of the ureters is enhanced. Occasionally, however, the uterine artery comes directly off the anterior trunk of the internal iliac and runs a much more oblique course almost parallel to the ureter, with which it may be confounded. In the process of clearing the pelvic floor a number of large veins are usually opened up. To secure vessels in the depth of the pelvis, we have found no instrument so useful as a long pair of fenestrated swab-holding forceps, which not only pick up a large piece of tissue, but are very easy to tie over, since the rounded shape of the end prevents the ligature gripping the forceps. On one occasion we found it necessary to ligature the anterior trunk of the internal iliac artery, such a course being forced upon us owing to the very extensive pelvic dissection that was necessary to extirpate the growth.

Cancer Infection of the Operation Area.

To obviate this Wertheim places special clamp forceps across the vagina, above the line of its contemplated division.

The application of these forceps is not always easy. We have tried several patterns after the models of Wertheim and Howard Kelly, but have found all of them inconvenient in difficult cases and more or less liable to slip and pull off at the critical moment of amputation. We have therefore devised a new pattern, which are applied in the antero-posterior vertical plane. The blades are joined at a T angle to a pair of shanks sufficiently curved to embrace the mass to be removed, and additional grip is obtained by serrating them longitudinally and giving them

a "spring" similar to that characterizing Doyen's smaller clamp forceps. Two pairs of finger rings are provided, of which the lower are used for purposes of adjustment and the upper to obtain the necessary force when clamping.

We have found this instrument superior in every way to the other patterns we have used. It is easy to apply, it cannot slip, and it makes an excellent tractor. It has been admirably made for us by Messrs. Maw and Sons, of Aldersgate Street (Fig. 1).

Fig. III.—Case 7.

Fig. IV.—Case 8.

Septic Infection of the Operation Area.

In cases in which the growth is not breaking down, and the patients are free from offensive vaginal discharge, the risk of serious septic infection of the operation area should be slight. A certain amount of infection of the extensive raw surface that is left in the pelvis is perhaps inevitable, and most cases manifest a slight amount of fever, accompanied by a vaginal discharge during the second week of convalescence. When the cervix is extensively ulcerated, or when a fungating and stinking mass fills the vaginal vault, the probability of serious infection of the operation area becomes much enhanced. Most of our cases have been scraped and cauterized some days before the major operation, but even with the greatest care it is sometimes difficult or impossible to entirely clean up the cervix. If the scraping and cauterization is very extensive, the peritoneal cavity may be opened by the curette perforating the thinned vaginal vault or cervix, or these tissues may be so attenuated that they tear whilst pulling up the uterus preliminary to its removal. Both these accidents have happened to us. On the other hand, if a free collection of offensive discharge from a putrid cervical mass be present in the vagina during the operation, some of it is almost certain to escape into the pelvis as the vagina is cut across. We think that the best procedure is that suggested by Mr. W. Fisher, the Resident Medical Officer of the Chelsea Hospital for Women—namely, to thoroughly scrape and cauterize the growth two days before the radical operation, and during this period to daily apply pure carbolic acid through a speculum. Douches of formalin (1 in 1,000) are also given, and immediately preceding the operation a final application of carbolic acid (without an anaesthetic) is undertaken, and the vagina is packed with iodoform gauze. During the manipulation involved in removing the uterus a certain amount of vaginal discharge and debris is squeezed into the vagina. Immediately before

the amputation the gauze plugging is withdrawn, carrying the discharge with it and leaving the vagina clean. Nevertheless, in some cases we have found it impossible to ensure the discharge being absolutely sweet, and it is a remarkable thing that the pelvic tissues exposed during the operation escape infection in the way they do. We have reason to believe that they acquire a degree of local immunity owing to their proximity to the offensive mass, for in three of our cases superficial necrosis of the parietal wound occurred apparently as a result of infection by the vaginal contents, whilst the operation area recovered satisfactorily. In all our cases except one we have left the upper end of the vagina wide open into the operation area without any gauze packing.

Septic Infection of the Bladder.

For a week or two all the patients suffer from inability to completely empty the bladder, and from this reason alone there is a tendency towards cystitis. This tendency is increased by the extensive denudation of the outer wall of the bladder in the region where it has been separated from the supravaginal cervix, vagina, and parametric tissue. In regard to this we have pointed out that the area of bladder attachment to the cervix, normally about $\frac{3}{4}$ in., becomes greatly elongated owing to the enlargement of the cervix produced by the carcinoma. In addition, this raw area of the outer bladder wall directly bounds the large subperitoneal cavity left by the operation, a cavity that in all cases subsequently becomes more or less infected. The appearance of pus in the urine under these circumstances is not surprising. The bladder, therefore, should be catheterized twice a day and washed out with a solution of boric acid. If this routine be carried out cystitis will not occur, or occurring, will be of short duration.

Septic Infection of the Abdominal Wound.

Owing to the long duration of the operation in some cases and the degree of manipulation involved, the edges of the abdominal wound may become bruised and devitalized. There is, therefore, a great probability of sloughing or suppuration if during the operation they become infected by septic organisms. Where the cervical growth is breaking down and stinking, and complete cleansing by scraping, cauterization, and antiseptic applications is not possible, the abdominal wound may easily be infected by the vaginal contents after the amputation.

In three of our cases (9, 10, and 12) this accident appears to have happened. In each of them, on the third day

after the operation, when the Michel's clips holding the skin edges together were removed, a foul discharge was noticed oozing from the lower end of the wound. The skin edges were immediately separated along its whole length, and the cellular tissue, fascia, and muscle edges were found in a condition of sphacelus. In spite of this, the skin itself was not even reddened, nor was the patient's general condition apparently affected by it.

Dressings soaked in peroxide of hydrogen were immediately applied, and in twenty-four hours the wound had a clean appearance. In the last case, a bacteriological sample was submitted to Messrs. Foulerton and Hillier, and an anaërobic organism was isolated, but the causal relation borne by it to the condition described will be further investigated. From the facts that the slough had in all the cases exactly the same appearance and odour as that characterizing the breaking-down carcinoma, and that

the free opening of the wound to the air and the application of peroxide of hydrogen immediately restored a healthy condition, it would appear almost certain that this peculiar occurrence was due to infection by organisms (probably anaërobic) that pre-existed at the site of the carcinoma.

The prevention of wound infection is therefore an important matter. It is to be effected:

1. By procuring as complete a cleansing of the cervix and vagina as the case will admit of.

2. By shortening the operation as much as possible, and so saving the wound edges from needless exposure and manipulation.

3. By covering those edges with a layer of sterile linen; and we find that the best way to effect this is to deliberately stitch the edge of a sheet of this material to the peritoneum on each side of the incision immediately after the abdomen has been opened. Less manipulation of the wound edges is required if a mechanical retractor, such as Doyen's, be used; but these instruments, though admir-

able in a simple case, do not give that maximum accessibility to all parts of the operation area which is afforded by the gloved hand used as a retractor. For this reason we are dubious as to their advantages in really difficult cases.

The Duration of the Operation.

The value of time in this operation cannot be over-estimated. Up to an hour and a half the patients stand the manipulations well, but after this period every ten minutes increases the amount of shock very materially.

Fig. 5.—Case 9.

Fig. 6.—Case 10.

A perusal of our table of cases shows that the time taken by the operation has in our hands varied from 55 to 165 minutes. This shows the striking variance in the difficulty of the operation that obtains in different cases, a factor which is beyond the control of the operator. The difficulties become enormously enhanced when dealing with fat patients, and where there is extensive infiltration of the cellular tissue or adhesion to the bladder. We have found that cases presenting extensive infiltration and cancerous hypertrophy of the cervix without ulceration are very much more arduous to deal with than those exhibiting excavation or fungosis. In particular the surgeon should try to avoid injury to the bladder, for the extra time taken to suture the rent is a great handicap to the patient. In all advanced cases a condition of chronic adhesive salpingitis is present which delays the operation and makes the exposure of the ureters more difficult. The amount of oozing from the extensive raw surface left after the extirpation varies greatly. In some cases, particularly early ones, it is very slight, but where the growth is extensive it may be considerable, and time is unavoidably lost in arresting it.

Summary of Results.

Our cases are collected in the table; 3 cases were lost as a result of the operation (Cases 1, 14, and 15).

Case 1 was very advanced and her general condition poor. Of all our patients, this was the only one in which the upper end of the vagina was closed by suture. Her condition on the morning of the next day was very satisfactory, but from this time she rapidly lost ground. There is therefore some reason to believe that toxic absorption from the closed-in operation area was responsible for the result.

Case 14 was extremely advanced also, the cervix and vagina being extensively ulcerated and the discharge horribly foul even after preliminary preparation. Here again it is more than likely that toxic absorption played a part in the result (Fig. VIII).

Case 15 was the most formidable we have undertaken. The patient was extremely fat, rendering access to the pelvis difficult, whilst the immense hypertrophy of the cervix increased the area of bladder attachment to it to something over three inches. Moreover, the bladder was morbidly adherent, and stripped back with difficulty. In this process it tore, and the additional time taken to suture the rent was the determining factor in the failure of the operation. The patient never recovered, and died

about twelve hours afterwards. This was the more deplorable since, in spite of the extensive local growth, an autopsy failed to find any evidence of carcinoma remaining in the pelvis or elsewhere. Had the operation been concluded half an hour earlier, this patient would probably have made a good recovery (Fig. IX).

In Case 2 a uretero-vaginal fistula due to necrosis of the left ureter occurred. The growth was extensive, and a long length of ureter on each side had to be isolated.

The defect declared itself at the end of the first week, and marred what would otherwise have been a good recovery. After waiting two and a half months without sign of spontaneous closure, the patient begged to be relieved of the annoyance from which she suffered. Mr. J. Thomson Walker kindly examined the bladder, and reported that the left ureter was at fault. The left kidney was exposed in the loin, and a solution of methylene blue was injected with a serum syringe into its

pelvis through a puncture in the cortical convexity. After waiting for ten minutes the blue solution appeared in the vagina, whilst the urine catheterized from the bladder remained normal in colour. The kidney was therefore removed and the patient made a speedy recovery. For three months after this she apparently enjoyed good health. Symptoms of acute nephritis then manifested themselves, and death occurred fourteen days afterwards with final suppression of urine. The autopsy revealed a mass of recurrent growth on the right side of the pelvis, but not obstructing the ureter. The right kidney was in a condition of acute tubular nephritis.

In Case 3 a vesico-vaginal fistula occurred which has considerably diminished in size, so that the patient is able to hold a certain amount of urine in the bladder, and there is good hope that very shortly it will close altogether.

In Case 12 a rectal fistula occurred, but at the time of writing has become much smaller.

For the rest, the results must be

considered entirely satisfactory, especially when it is remembered that only 2 out of the 18 cases was sufficiently early to have been dealt with by vaginal hysterectomy.

Of the 15 cases that recovered from the operation, 14 are alive and show no signs of recurrence. The time that has elapsed, however, is so short that no stress is to be laid on this. Rather would we point to the improvement in the aspect of the patients, their increase in weight, and the pleasure and relief with which they view their escape from their distressing symptoms, temporary though it may

Fig. VII.—Case 11.

Fig. VIII.—Case 14.

be. These facts in themselves constitute a strong plea for the operation.*

On the Justifiability of the Operation.

The operation being still upon its trial in this country, there are not wanting those who regard it unfavourably, holding that the risks attendant on it are too great to be compensated for by the increased operative scope and the lessened chance of recurrence that it affords. Answers to this objection may be given from several standpoints. Dealing first with the technical difficulties, our experience teaches us that these are not due to the operation *per se*, but to the patient. That this is so may be proved by performing the operation on the cadaver, when the entire technique (given a normal condition of the pelvis) may be carried out in fifteen minutes or less; and in conformity with this we have found that when dealing with an early case, such as Nos. 5 or 17 on our list, the operation presents no difficulties beyond those met with in many well-established surgical procedures. The difficulties increase *pari passu* with the advancement of the disease—a feature common to all surgical work, but one that cannot fairly be used to disparage the technique of the operation. In other words, it is not the operation that should be criticized, but its application to particular cases. We ourselves believe that in a few years this operation will be the only one carried out for the cure of carcinoma of the cervix.

The Operation from a Pathological Standpoint.

Passing to a consideration of the operation from a pathological standpoint, we believe that its value is manifest. The advance of a carcinomatous growth takes place in two ways. First, by a gradual pressure destruction of the tissue surrounding it—"infiltration"; and, secondly, by a growth insinuation along trunk lymphatic channels—"permeation." The distinction between these two methods of growth has lately been insisted on by Sampson Handley, and is very important. The first is seen at the macroscopical growing edge, where a remarkably abrupt line between the carcinoma and the surrounding tissues is exhibited. The second is evidenced by the carcinomatous lymphatic glands and secondary nodules occurring at a distance from the primary growth. The distinction is exemplified by a clinical course of a rodent ulcer and an epithelioma respectively. In the first we have a growth by infiltration alone; in the second both by infiltration and permeation. Had we to deal with a tumour growing solely by infiltration, it would be possible to permanently remove it by an incision just outside its abrupt macroscopical margin; but growth by permeation requires a wide removal of the entire lymphatic tract to render it successful.

Growth by infiltration is occurring around the whole periphery of a carcinoma, but growth by permeation only along certain well-defined lymphatic channels. Applying these general considerations to carcinoma of the cervix, we see that the distinction between these different methods of growth is well preserved. Thus the bladder, rectum, and vagina are involved by *infiltration*, a slow process taking many months or a year or two to

cross the short length of tissue that separates them from the cervix. The pelvic glands, on the other hand, are involved by *permeation*, a much faster method of extension, by which the many inches of tissue intervening between them and the primary growth may be spanned in a few weeks. Now, the lines of lymphatic conduction in the case of the cervix are few and simple, and run, as we have shown, straight outwards through the parametrium to the external iliac glands.

The demands of pathology are therefore satisfied by an excision so planned as to include this tract, whilst keeping just outside the periphery of the macroscopic growing edge elsewhere. Wertheim's operation does this, and more; and it is, therefore, a rational treatment even where the edge of the growth is separated from the bladder or rectum by the twentieth part of an inch of uninfiltreated tissue. But growth by permeation does not always occur in these patients. Archibald Leitch,¹ analysing 915 cases of carcinoma of the cervix on whom an autopsy had been performed, found glandular deposits in only 38.36 per cent. of them, whilst no less than 55 per cent. were free of metastatic growths in any situation!

Dr. MacCormac, working on a new series in the same laboratories, tells us that of 75 cases he has analysed only 33 per cent. had glandular deposits that could be demonstrated by the microscope, and it is the general experience

of the workers in these laboratories, amongst whom one of us has the honour to be numbered, that of all the common sites of carcinoma the cervix is that in which metastases (and therefore growth by permeation) are least common.

These facts are worthy of much consideration, and shed a hopeful light on the surgical problem of carcinoma of the cervix.

A study of our small series of cases shows that the glands were normal in 5, enlarged but not carcinomatous in 7,

and carcinomatous in 6. This precarcinomatous enlargement of the lymphatic glands has been specially drawn attention to by one of us lately.² It is important, from the point of view of these cases, in teaching us that mere glandular enlargement, though considerable as discovered by the preliminary examination of the pelvis, which constitutes the first step in the operation, is no contraindication to the surgeon to proceed, for such glands may prove to be non-carcinomatous.

Lastly, we may estimate the value of the operation by its results. Archibald Leitch,³ studying 900 cases of cancer of the cervix on whom no surgical operations had been performed, found that the average duration of life from the first appearance of symptoms to the death of the patient was one year and nine months.

The average duration of the symptoms of our patients was six months, so that one year and three months was the average life expectation of each of them.

The statistics published by Wertheim as to the ultimate results of his large number of cases are well known, and we need not refer to them more than remark that of those who survived the operation, 60 per cent. are claimed to have been alive five years afterwards.

Our own cases are far too recent to allow of any deduction being made from them as to ultimate results, and at the present time it is not on this ground that we would base what appears to us to be one of the principal

Fig. IX.—Case 15.

* Since this paper was written Case 9 has developed marked signs of recurrent growth in the abdomen.

Tabular Report of the Authors' Cases of the Radical Abdominal Operation (Wertheim) for Carcinoma of the Cervix.

Case.	Where Operated On.	Operator.	Age of Patient.	Duration of Symptoms.	Condition of Cervix.	Condition of Pelvic Cellular Tissue.	Condition of Pelvic Glands.	Duration of Operation.	Result of Operation.
1	Chelsea, Reg. No. 210	Bonney	44	3 months	Extensively ulcerated; very offensive	Both broad ligaments infiltrated	External and common iliac glands of both sides carcinomatous	1 hr. 40 min.	Death; autopsy, "shock."
2	Chelsea, Reg. No. 373	Bonney	41	6 months	Brawny infiltration; no ulceration or offensive discharge	Both broad ligaments and utero-sacral ligaments infiltrated	External iliac glands on right side carcinomatous	1 hr. 40 min.	Recovery; left ureteral fistula developed sixth day; left nephrectomy two and a half months later; recurrence in right side of pelvis and death six months later.
3	Private	Berkeley	37	9 months	Diffuse infiltration; beginning ulceration; not offensive	Growth adherent to bladder	Normal	1 hr. 50 min.	Recovery; vesical fistula.
4	Private	Bonney	45	3 months	Ulceration and infiltration, especially on left side; not offensive	Left broad ligament extensively infiltrated; growth adherent to bladder	Normal	2 hrs.	Recovery; convalescence uninterrupted.
5	Private	Bonney	50	1 month	Early ulceration limited to cervix on left side; not offensive	No infiltration	Normal	1 hr. 20 min.	Recovery; convalescence uninterrupted.
6	Chelsea, Reg. No. 158	Bonney	45	3 months	Excavating ulceration of cervix; very offensive (Fig. II)	Both broad ligaments infiltrated; growth adherent to bladder	Left external iliac glands enlarged, but not carcinomatous	1 hr. 30 min.	Recovery; small stitch sinus in abdominal wound.
7	Middlesex, Reg. No. 74	Berkeley	57	3 months	Diffuse infiltration; early ulceration; only slightly offensive (Fig. III)	No infiltration	External iliac and broad ligament glands enlarged, but not carcinomatous	1 hr. 20 min.	Recovery; a good deal of fever and vaginal discharge.
8	Middlesex, Reg. No. 85	Berkeley	48	4 months	Infiltrating growth with ulceration; moderately offensive (Fig. IV)	Slight infiltration of both broad ligaments	Left parametric gland enlarged, but not carcinomatous	1 hr. 30 min.	Recovery; convalescence uninterrupted.
9	Chelsea, Reg. No. 240	Bonney	47	12 months	"Cauliflower growth" mass the size of a fist; posterior vaginal vault involved; horribly offensive (Fig. V)	Both broad ligaments moderately infiltrated	Right external iliac and left parametric glands enlarged, but not carcinomatous	1 hr. 20 min.	Recovery; sloughing of abdominal wound.
10	Chelsea, Reg. No. 248	Bonney	43	4 months	Fungating growth involving vagina; horribly offensive (Fig. VI)	Both broad ligaments and left utero-sacral ligament infiltrated	Left parametric glands and right common iliac glands carcinomatous	1 hr. 18 min.	Recovery; sloughing of abdominal wound.
11	Middlesex, Reg. No. 100	Berkeley	59	6 months	Extensive ulceration of cervix; not offensive (Fig. VII)	Left broad ligament infiltrated	Left parametric glands carcinomatous and breaking down	1 hr. 15 min.	Recovery; cystitis and considerable fever.
12	Middlesex, Reg. No. 103	Berkeley	32	5 months	Extensive ulceration of cervix involving vagina; very offensive	Broad ligaments of both sides infiltrated	External iliac glands of both sides enlarged, but not carcinomatous	1 hr. 45 min.	Recovery; sloughing of abdominal wound; rectal fistula.
13	Middlesex, Reg. No. 106	Berkeley	37	7 months	Fungating mass, size of a small orange, involving vagina; very offensive	Broad ligaments on both sides infiltrated	Parametric glands enlarged, but not carcinomatous	1 hr. 15 min.	Recovery; convalescence uninterrupted.
14	Chelsea, Reg. No. 324	Berkeley	52	2 years	Very extensive ulceration, extending widely on to vagina; horribly offensive (Fig. VIII)	Both broad ligaments and utero-sacral ligaments infiltrated	External iliac glands and parametric glands on both sides carcinomatous and breaking down	1 hr. 45 min.	Death; autopsy, "shock."
15	Middlesex, Reg. No. 123	Bonney	45	7 months	Infiltrating growths producing great hypertrophy of the cervix; ulceration just beginning; not offensive (Fig. IX)	Both broad ligaments and both utero-sacral ligaments infiltrated; growth adherent to bladder	Normal	2 hr. 25 min.	Death; autopsy, "shock."
16	Chelsea, Reg. No. 357	Berkeley	45	6 months	Ulcerating growth, not offensive	Both broad ligaments infiltrated	Left parametric gland enlarged but not carcinomatous	1 hr. 20 min.	Recovery; uninterrupted convalescence.
17	Middlesex, Reg. No. 147	Bonney	49	2 months	Fungating growth limited to the posterior lip of the cervix; not offensive	No infiltration	Normal	55 min.	Recovery; uninterrupted convalescence.
18	Middlesex, Reg. No. 174	Bonney	41	6 months	Infiltrating growth producing hypertrophy of the cervix; not offensive; adhesion to rectum	Early infiltration of both broad ligaments	One large carcinomatous gland on left external iliac artery; the rest of the external iliac glands on both sides enlarged, but not carcinomatous	1 hr. 40 min.	Recovery; fever and local suppuration.

justifications for the operation—namely, the gain in any event to the patient who recovers of a period of hopeful life.

REFERENCES.

¹ Fifth Report of the Middlesex Hospital Cancer Investigation Laboratories, 1906. ² Victor Bonney, Hunterian Lectures, Royal College of Surgeons, 1900. ³ Fifth Report of the Middlesex Hospital Cancer Investigation Laboratories, 1906.

OXYGEN AND MUSCULAR EXERCISE AS A FORM OF TREATMENT.

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FROM further observations made on athletes, on myself, and on horses, I have come to the conclusion that oxygen inhalation followed by, or accompanying, exercise is a most active and effective form of treatment. I have confirmed the results obtained by Mr. Martin Flack, Mr. Just, and myself on athletes, and these results have also been confirmed in America by observations on swimmers made by Professors E. Smith and Gies and Dr. Darlington, and also by Mr. Martin Flack, who demonstrated the effect of oxygen on Wolfe in his last Channel swim. Wolfe refused the help of oxygen until he was so far done that he talked about coming out and was thoroughly disheartened. On breathing oxygen, the done-up man, who was wasting his breath in talking, quieted down; his breathing became slower and less distressed, he stopped talking, and "plugged" away again in workman-like fashion. The sculls had to be again taken out and used to keep the boat up with the swimmer; before, he and it had been drifting with the tide. So long as Wolfe complained of being done up, a fresh administration of oxygen restored him; but after some time he complained of being "frozen," and at last gave up, after the oxygen had kept him going for an hour and a quarter, and brought him within almost a quarter of a mile of the shore. Within a few minutes of being taken out Wolfe was helping to clean the grease off his body. His respiration and pulse were both good. It was the cold that prevented his finishing his great effort.

By the kindness of two neighbours—dairy farmers—I have been able to prove that horses in their ordinary condition, resulting from the wear and tear of daily life, are able to climb hills faster and with far less distress after breathing oxygen. For example, I quote the case of a horse, which for five years had been a tram-horse, and is now somewhat short of wind, although strong and willing. This horse, urged by the driver, pulled him and me in a milk cart up a steep hill in three and a half minutes; the animal was blown by the effort, its respiration deep and panting, and on turning round walked all the way down the hill. On then giving it oxygen, the panting at once became less and quickly subsided. After breathing oxygen for ten minutes, we set off for the hill once more; the usually staid horse set off at a gallop for the foot of the hill, and reached the top in 2 min. 8 sec. The panting and distress of the animal were far less in this case, and on turning round the horse at once trotted briskly down the hill. In another case a milkcart horse after breathing oxygen for ten minutes set off on its daily round. When it came to a hill which it habitually walks up it trotted up to the top and effectively winded me. I was following on my bicycle, and had omitted to fill myself with oxygen before the start.

In striking contrast with these horses is the case of a racehorse in perfect training, on which I was able to try oxygen by the kindness of Mr. W. R. Clarke, of Debenham Hall. Mr. Clarke had two two-year-old horses which had just finished their racing season, and were going out of training. They were in the perfection of their youth, and in the perfection of condition, having been bred out of the best blood, and trained for a year with that tireless, patient attention and fullness of knowledge which alone produces these masterpieces of art. Running one's fingers down the side of these horses, it was not possible anywhere to pick up a fold of skin. The muscular, circulatory, and respiratory systems were built up to the perfection of their working powers by graduated exercise, massage, and diet, the exact control of which had been in the hands of the trainer since the horses were yearlings.

The form of these horses was known exactly; a week before one had beaten the other in a six-furlong race by four lengths. To the loser I gave oxygen for fifteen minutes, and the two horses then trotted gently down to the starting post, and arriving there started on the six-furlong race seven minutes after the inhalation. The result showed that the form was not altered in the slightest degree. The horses were neither blown or distressed by the race, and, as the trainer said, "a candle held in front of their nostrils would not have been blown out." These animals were so fully supplied with oxygen that the result depended simply on their relative muscular power. Durig has shown on the resting man that excess of oxygen has no influence on metabolism, and this appears to be the case in the working horse or man so long as the supply is adequate. If heart and lung fail to give enough oxygen to the muscles the working power is lessened, and then oxygen-breathing has its effect, not otherwise. Neither heart nor wind failed the perfectly trained racehorse in a sprint of this length.

In agreement with this result I find that two men thoroughly trained in the use of a work machine and inured throughout their lives to heavy work do not increase their output of work in a two-minute period; while I, quite untrained to the effort, am able to do so to a notable extent on breathing oxygen beforehand. The work consists of lifting a 60 lb. weight 20 in. high by means of a pulley and rope worked simultaneously by hand and by a foot-pedal. In the two-minutes period I lost my breath, the workmen did not. Breathing oxygen continuously with the aid of the Fleuss Siebe Gorman dress—designed for rescue work in mines—these two men lifted the weight in two hours 1,461 and 1,315 times respectively. The breathing bag became very hot during these extreme efforts owing to the active absorption of the exhaled carbonic acid by the caustic soda in the bag. This was against the men. Wearing the apparatus but breathing air in place of oxygen, the men lifted the weight 1,267 and 1,219 times respectively, and in this case they were not impeded by a hot breathing bag. Thus in one case the increase in work done under oxygen was one-sixth and in the other case one-twelfth. The man who did one-sixth more is one possessing great nervous energy and resolution to carry out the tests thoroughly. In my own case I have found myself able to ride hills on my bicycle after breathing oxygen which I could not ride without. The breathing after such an effort is deep, owing to the CO₂ produced, but not distressing. The heart is working rapidly but not with any sense of discomfort or feeling of dizziness or anxiety. During the vacation oxygen has unquestionably enabled me to take harder exercise and to get the exhilaration from such exercise, and has got me into training for climbing hills which I never should have attempted without it. I have had a tobacco heart and 1,000 c.cm. knocked off my vital capacity by a pleurisy, and so consider my hill-climbing efforts under oxygen a great improvement on my former condition.

In the case of a Marathon runner who came to me for a trial of oxygen in the first week of his training, I found after I had let him run five miles, that oxygen lessened his time for another three-quarter mile by thirty-eight seconds. There can be no question that its influence is very great on the untrained or fatigued man. It enables a man to increase very considerably the metabolism of his body. It should be, therefore, of value in the treatment of people fat and scant of breath, and those who over-eat and take too little exercise, and in cases of emphysema and of heart disease treated by graduated exercise. Possibly it may find a use in tropical climates to make exercise easier, and in men exhausted by the day's mental work and worry, and who want a spin on their bicycle to make the blood circulate and the appetite good. To make the trial of oxygen easy and simple I have constructed a little apparatus—a combined generator and inhaler. With this oxygen can be made almost as easily as soda water with a gazogen. The apparatus consists of a rubber bag with a mouthpiece and tap at one end and metal pot attached to the other end. Into the pot, which is held higher than the bag, a cube of oxalith (Na₂O₃) is put, and into the bag, squeezed empty of air, 2 or 3 pints of water are introduced. Bag and pot are then closed, and some of the water allowed to run from the bag into