

RADIOTHERAPY IN OVARIAN CARCINOMA

A DISSERTATION

in support of candidature for the

DEGREE OF DOCTOR OF MEDICINE

in the

UNIVERSITY OF GLASGOW

by

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June, 1952.

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Apologia.

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Unanimity in the discussions on the subject of the treatment of ovarian carcinoma exists only with respect to the need for a larger series of cases than those previously presented. The place of radiotherapy has been impossible to define because of the absence of reports on a control series, comparison with purely operative treatment being achieved only on cases treated at another time and place, recorded by different authors, and classified under varied groupings.

In the Liverpool region of the North-West of England it has been possible to collect all the case-records of cancer patients registered in the hospitals from 1944 onwards. An excellent system of tracing by regular hospital examination, annual report from doctor, patient or relative, and obtaining information from death certificates allows records to be made of the state of health from the time of registration onward.

On the subject of cancer registration in England and Wales, the chief medical statistician of the General Register Office, STOCKS (1950) stated (p.6) "one or two regions, notably Liverpool, have pressed forward towards the necessary goal of registering also the surgically treated and untreated cases and have succeeded in bringing in a satisfactory proportion of all the new cases of cancer coming to the notice of doctors within their region."

His enquiry into treatment of cancer and its results provoked the statement (p.5): "the ever-increasing costliness of radiotherapeutic treatment makes it imperative that we should be able to assess the relative merits of different forms of treatment of cancer affecting particular sites. Furthermore, the subjection of patients to some unnecessarily painful or unpleasant method of treatment, under the impression that it offers better expectation of cure or alleviation than another simpler method, should not be allowed to continue for long periods of years in the absence of evidence that the impression is correct."

6 Albemarle Road,  
Norwich, Norfolk.

8th October, 1951.

Abstracts from the Literature.  
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The series numbered 1, 24, 25, 23, 18 and 6 in table 2 provide figures based on all the cases seen at the hospital concerned, including those proved by section, those whose diagnosis was clinical, the treated and the untreated.

The highest figure 31% is claimed by No.1, Allan and Hertig (1949), who found (a) that in a series of 265 cases the addition of XRay therapy to operation significantly increased the apparent cure-rate at five years, on the crude figures from 29% to 46%. (b) Serous cystadenocarcinoma formed 60.3% of all cases, but no significant difference in results was shown from other carcinomas. Pseudomucinous carcinoma was found in 20.3% cases with a cure-rate of 47%, whereas the 9.1% cases of undifferentiated carcinoma showed only 18%, the difference being significant. (c) The presence at operation of metastases in 52% cases significantly reduced the cure-rate from 49%, for those with no metastases, to 21%. (d) The addition of XRay treatment did not improve the results of either exploration, biopsy, oöphorectomy or supravaginal hysterectomy with oöphorectomy but, in 32 cases treated by complete hysterectomy with oöphorectomy, the percentage increased from 27 to 65, for the 17 cases who received XRay treatment, the number of cases being too small to give this difference great significance. (e) Treatment by oöphorectomy did not show improvement over simple exploration, with biopsy in some cases, the number of cases in the groups

treated by XRay therapy being only 21 and thus giving unreliable percentages. On the other hand, supravaginal hysterectomy was an advantageous addition to oöphorectomy, only in the series where no XRay therapy was given. The complete hysterectomy showed no superiority over the supravaginal, on statistical analysis, although the authors thought it seemed to have a slight advantage. The results from any operation other than hysterectomy with bilateral oöphorectomy were negligible, these authors state, but 19% of the 53 cases treated by oöphorectomy, with or without XRay therapy, were apparent cures for five years at least. Of all the cases seen, 83.5% were operable.

(f) The apparent cures at 10 years still showed a significant difference in favour of the addition of XRay therapy but, fifteen years after treatment, only 14% of each series were alive and well. (g) Pre-menopausal patients had a better prognosis than post-menopausal, but formed only 39% of the cases.

The aggressive policy with regard to operative treatment, employed at the hospital which supplied these figures, is emphasized by Pemberton (1940) who considers it wise to remove the omentum, regardless of gross metastases. His proportion of radical operations (hysterectomy with bilateral oöphorectomy) is 105 in 149 or 70%, whereas only 8 operations proved to be merely exploratory. Sixty cases survived five years, a percentage of 40. The ratio of cured to operable cases is thus 60 to 141 or 42.5%†4.16.

No.24, Wetterdal (1949), reports a 20% cure-rate in 145 cases seen. (a) Treatment by complete operation gave 56%

apparent cures at five years, significantly better than the 13% of those treated by an operation at which metastases were found. Post-operative XRay therapy was used in each case. Of his total cases, 64% were operable. No significant difference was shown between partial operation and complete operation or between partial operation and cases with metastases present. (b) Treated cases with metastases were not significantly improved in comparison with those cases who were untreated, tapped or only explored.

No.25, Williams (1944), found that 18% of 213 cases, previously untreated, were alive and well five years later. No significant difference was shown between those receiving additional XRay therapy after operation and those treated by operation alone, the classes (1) unilateral carcinoma, (2) bilateral carcinoma, (3) pelvic metastases, being considered either separately or together. Cases treated by XRay therapy, showing pelvic metastases, had a better prognosis than cases with abdominal extension. Cases having carcinoma confined to one ovary gave a better prognosis than those with pelvic metastases, however treated. No significant difference was shown between bilateral carcinoma and unilateral, or, between bilateral carcinoma and cases showing pelvic metastases. Of the new cases, 43% were operable. In 26 cases, laparotomy produced a mortality of 23%.

No.23, Walter, Bachman and Harris (1941), reported 153 cases seen, of whom 12% were apparently cured at five years. (a) Early cases formed 36% of the total but no difference of significance could be shown between treatment by operation alone and treatment

by operation and XRay therapy, either in the early cases or in the advanced cases. (b) There was no advantage proved in the use of adequate XRay instead of inadequate XRay therapy. A mortality-rate of 9.8% was obtained. The authors advocated a course of XRay therapy to patients suffering from residual tumour, after an incomplete operation, rather than persistence in an attempt to remove extensive areas of growth, by a protracted operation.

No.18, O'Donoghue (1949), claimed <sup>that</sup> only 9%, of the 75 cases seen, remained alive and well five years. Among the different methods of treatment it could not be statistically shown that oöphorectomy gave better results than either exploration of the inoperable cases, or leaving the inoperable cases without treatment, because only sixteen cases were treated by oöphorectomy. The radical operation of hysterectomy and oöphorectomy was not significantly better than simple oöphorectomy. He found 65% of his cases were hopeless on admission, and 30% operable. The average number of months survived by the cases in different stages was: I,38; II,36; III,19; IV,5.

No.6, Helsel (1946), had only 4%, of 92 cases seen, as apparent cures at five years but 35% cases were untraced. If it is assumed that the untraced were cured, the percentage becomes 39 but if these cases are excluded the percentage rises only to 7. Two-thirds of his cases were hopeless on admission. In three-quarters of the cases only partial removal of the tumour was achieved. His immediate mortality was one-sixth of all treated.

The average duration of survival after treatment was 35.3 months for operation with XRay therapy combined and, for operation alone, 11.7 months. Symptoms had existed less than 2 months in one-third of the cases. More than half the cases were post-menopausal. Only 5.5% of the tumours were solid, however, papillary cystadenocarcinoma forming 62 out of 92 or 67.5% of the primary growths. Half of the operations were radical, being hysterectomy in 39, simple oophorectomy in 19 cases. Cashman and Helsel (1949) emphasize that operation should be employed in all cases of ovarian cancer. Removal of the ovary, with or without the uterus and invaded omentum, should be followed by XRay treatment. Even when peritoneal spread is evident, the ovary should be removed.

Summing the crude numbers in these six series, it is found that 20% of 908 cases seen were apparently cured. The number of operable cases was 54% of all cases seen. The ratio of cured to operable cases is thus 36.5%, individual series giving ratios not significantly different. It is therefore very likely that the cure-rates obtained are influenced by the number of operable cases, in each series, and are unaffected by the type of radio-therapeutic supplement or, indeed, by the addition of any radio-therapy. Authors No.1 and No.25 give suggestive indications that the addition of XRay therapy is useful but the evidence is not conclusive.

The other 19 series are based on the cases treated, but the total number, from which the selection of cases has been made, is not mentioned.

No.10, Kerr and Einstein (1945) treated their 95 malignant cases by operation and XRay therapy, to a tumour dose of more than 2000 r in an unstated period. They found the tumour dose was not related to survival, but obtained 40% apparent cures. In 50% of their cases the pathologist's examination revealed papillary serous adenocarcinoma. 75% of their cases showed residual growth, ascites, contamination of the abdominal cavity during operation, recurrent growth or were so advanced as to be inoperable. The commonest age affected was in the group 40-60 years.

In 1951 Kerr and Elkins reported the results, including those above, in patients treated from 1930 to 1944 inclusive. The percentage of five year survivors was 30.4% of 190 cases or 31.5% of 165 section-proved cases. Cystic carcinoma had a better prognosis, over 40%, whereas solid carcinoma showed only 16%. Technical details applicable to those treated from 1936 onwards:- 200 KV, 8 or 2 ma, 50 cm. FSD, 1.95 mm.cu HVL, dose to tumour 4000r in less than 5 weeks; six fields, each 15 x 10 cm., were arranged round the pelvis.

No.17, Norris and Murphy (1932) also obtained 40% of apparent cures among 125 cases treated, but at only 3 years interval after operation. No difference of significance was shown between unilateral carcinoma (two-thirds of the cases) and bilateral, or between unilateral and bilateral oöphorectomy, or between those with and those without adhesions, respectively. If 32 untraced cases be excluded instead of being assumed dead of cancer, the

percentage cure-rate at three years is 54% from treatment by operation. The mortality from operation was 10%.

No.7, Heyman (1930) provides a companion study to this series because the cases were reported about the same time, twenty or so years ago.

Operation, XRay therapy and Radium intra-cavitary insertion were used in each case, the uterus being conserved, when not apparently invaded, in order to carry the Radium applicators. No difference of significance was shown between unilateral and bilateral carcinoma. Early cases had a decidedly better prognosis than late cases, 66% of 32 compared with 23% of 30. The average result is 28 out of 62 or 45.2±6.3% of treated cases. Two five-year cures of inoperable cases were not pathologically verified. Operation was possible in 3 cases out of 5 given preoperative XRay treatment.

The method of treatment employed by Heyman is described by BLOCK (1947) thus:

"It is a routine procedure at the Radiumhemmet not to remove the uterus in cases of carcinoma of the ovaries. Radium placed in the uterus comes in closer contact with the area of recurrences than that which is placed in the vagina. One Radium application is made of 33-150 mg., intra-uterine or intra-vaginal, for 20 hours, giving 990-1500 mg. hrs. with the uterine applicator or 1800-3000 mg. hrs. with the vaginal. This is followed by deep XRay therapy to 2 anterior and 2 posterior fields, 400r being given daily to each field, for three days in the first series.

Three months later a second series is given for two days. After another six months 400r is given to each field, one field daily. Total dose 2400r in nine months."

No.5, Freed and Pendergrass (1948) treated 84 cases, with 39% success, by operation and post-operative XRay therapy. The early stage showed a very significant improvement over the late stage, 72% compared with 29%. Only 21.8% of the operations were mere explorations or incomplete operations. The ratio of cured to operable cases was  $50.2 \pm 5.46\%$ . Technical data: 160-200 KV, HVL 1 mm.cu, 4 fields 15 or 17 cm. square; alternatively, one anterior and one posterior field, 15 x 20 cm. each; 200r (air) to an anterior or posterior field daily, total 1500-3000r (air) in a series; rest 1-4 months; repeat 2, 3 or 4 times. The tumour dose in a series is thus roughly 1000r in 2 weeks, assuming 40% depth dose and a back scatter factor of 1.3 but this dose is not mentioned by the authors.

No.11, Leucutia (1947) in a series of 242 cases compared the effect of 200 KVp and 500 KVcp XRay therapy after operation. Up to the year 1937 no significant difference was shown. From 1938 to 1940 cases treated by 500 KVcp were significantly improved to 32% but the comparison was with cases treated in the period 1923 to 1937, of whom 17% were apparently cured. The 200 KVp beam was HVL 1.9 mm.cu delivering 20r per mm. at 50 cm. whereas the 500 KVcp of HVL 9 mm.cu delivered 20r per mm. at 60 cm. FSD.

No.19, Paterson, Tod and Russell (1950) report 30% cured of those treated by operation and XRay therapy. If all the 153

operation cases sent to the Radium Institute were included, that is, those too advanced in addition to those suitable for XRay treatment, it is found that 25% were apparently cured at five years.

(a) Nineteen early-stage cases, treated, gave the splendid result of 79% which is strikingly better than the 22% of 106 late cases, similarly treated. The presence of these few early cases hardly alters the average result. (b) Cases where no biopsy, or an indeterminate histological report, was obtained were 48 in number and showed a 15% survival rate, which was significantly lower than adenocarcinoma, 41%, and papillary cystic adenocarcinoma, 44%, but these latter were almost equal to each other. Correction by dividing the results throughout by the factor 0.95, in order to compensate for those who died from causes other than carcinoma of ovary, does not affect the figures more than 1% to 4% and is therefore not of much importance, in the age-groups considered. Tod (1951) adds the information that of 83 cases showing tumour residue who received complete treatment 28% were alive and well five years.

The method of treatment employed was operative, followed by XRay abdominal baths, as described by Tod (1943-44): Prophylactic treatment is not given, the four fields of size 15 x 10 cm. treating a pelvic area are condemned, the trunk-bridge beam-directing apparatus is used to aim two anterior 30 x 20 cm. fields tilted  $30^{\circ}$  from an antero-posterior plane. A posterior 30 cm. diameter circle is applied directly. The tumour dose is 3000r

in 3 to 4 weeks. The skin dose on the first day is 50r measured with back-scatter, increasing 10r daily until 100r is reached, treating six days a week, each area daily. 135% of the given skin dose, measured with back-scatter, is the maximum dose received throughout the pelvis in a practically uniform field, to give an example from an average case in which the skin dose received is 2850r from a given total dose of 2225r. The integral dose is 40 to 50 Me.gm.r in 21 to 24 days.

Later modifications are described by Tod (1951) where two posterior fields are also set on the trunk-bridge apparatus making a total of four fields 30 or 40 cm. long by 20 cm. wide. The dose is now reduced to 35r on the first day to each field, increasing 5r daily until 80r on each of four fields is attained. The tumour dose homogeneous through the abdomen and pelvis is 3000r in 28 to 30 days.

As an example of the proportion of cases of cancer of the ovary sent to the only radiotherapy centre of a large area, it was found that 46 out of an estimated 246, 19%, were treated in 1946 at Manchester.

No.16, Munnell and Taylor (1949) discussed the results of treatment by operation and XRay therapy, in 200 cases, finding 28% of apparent cures at five years. (a) Pseudomucinous carcinoma gave a better prognosis than serous, while that of undifferentiated carcinoma was significantly worse than serous carcinoma. (b) The results in cases of unilateral and bilateral carcinoma were not significantly different, but extension to

pelvic structures lowered the proportion of apparent cures. Metastasis outside the pelvis was not shown to have a worse prognosis than merely pelvic extension. There was a marked difference between the 65% cured of the section-proved early cases and the 8% of the late cases, section-proved.

No.8, Holmes and Schulz (1946) reported 24% of 25 cases, treated by operation and one million volt XRay therapy, alive and well five years. The tumour dose was 3000r in an unstated period

No.9, Jones (1941) found 23% of 30 cases alive and well five years after treatment by operation and 200 KV XRay therapy.

Technical data: 50 cm. FSD, 1 mm.cu+1 mm. Al filtration, 4 or 6 portals each 15 cm. square covering abdomen and pelvis, skin dose 4000r to 6000r or more over a 2-4 weeks' period. Assuming 40% depth dose and a back-scatter factor of 1.3 the tumour dose is probably 1500r in about 3 weeks, although this is not stated.

No.3, Diddle (1949) showed that a complete operation, clearing all evidence of carcinoma, gave 75% cures in 20 cases compared with 21% for all operations in 108 cases, a significant difference.

No.15, Montgomery (1948), in 68 cases, claimed 21% cures for operation and XRay therapy. Operation produced a mortality of 17%. although 42% of the operations were merely exploratory.

No.20, Swinton and Yancey (1947) gave 20% cures as their figure for operation and XRay therapy in 45 cases. The dose was 2000r through 2 anterior and 2 posterior portals, treating the pelvis, in an unstated time.

No.13, Marks and Wittenborg (1948) used 400 KV XRay therapy

after operation in 66 cases and also achieved 20% cures. Technical data: 50 cm. FSD, 0.9 mm. Sn+ 0.25mm.cu+1 mm. A $\frac{1}{2}$  filtration, 6 or 4 ports each 15 cm. square, 300r daily to a single port daily except Sunday, 1800r in air to each port. Assuming 45% depth dose and a back-scatter factor of 1.1, the tumour dose is probably 2000r in four weeks, although this calculation is not made by the authors. The course is stated to be repeated once or twice. In view of the repeated dose it is not surprising that of their 14 successful cases, the 3rd and 6th respectively in their paper, the only cases of postoperative residual tumour, required colostomy later because of irradiation stricture. The five-year survivals included 7 postoperative prophylactic treatments, 2 preoperative, 2 treatments of post-operative implants after pan-hysterectomy, while a postoperative recurrent case although alive five years from operation was not cured of disease. None of these cases can be considered worthy of credit as an irradiation success.

No.4, Ellis (1944) used XRay treatment or Radium and XRay treatment combined, after operation, finding 18% cures of 105 cases at five years but almost the same number, 20%, at three years. There was a significant difference for which he calculated the probability, in favour of cases with a complete operation compared with those who could only be treated by an incomplete removal of the growth. Cases showing definite recurrence or residual growth after operation received significant benefit from treatment by radiotherapy compared with those who had only opera-

tive treatment. A dose of 7000 mg.hr. was given when a Radium intracavitary application was added.

No.21, Taylor (1950) discussed the results of operative treatment of 161 section-proved cases in which 17% five-year cures were achieved. Solid carcinoma was significantly more dangerous to life than cystic although equally common. Histological grading showed differences of importance between the highly differentiated type and the others but no significant difference between the very anaplastic and the intermediate type. Pseudomucinous carcinoma was distinctly less malignant than serous carcinoma and was only one-third as frequent but anaplastic carcinoma was not significantly worse than serous. Spread beyond the ovary was already present in 37% of the cases, peritoneal in the serous type of carcinoma, lymphatic in the solid anaplastic type. About half of the cases showed bilateral ovarian tumours.

No.14, Meigs (1940) reported 16% cures of 154 cases treated by operation, XRay therapy being added in 64 cases. No significant difference was produced, either for solid carcinoma or for cystic carcinoma, by the addition of XRay therapy, although the results were worse in each type of tumour XRay-treated. The mortality of operation was 12.5% for solid tumours and 3.6% for cystic. Half of the cases were post-menopausal.

No.22, Taylor and Greeley (1942) compared 82 cases, treated by operation, with 56 cases treated by operation and 200 KV XRay therapy. The result of all cases treated was 15%. No significant improvement was obtained by the addition of adequate XRay treat-

ment but inadequate XRay treatment was associated with distinctly poor results. The operable cases formed 32% of the total and produced all but one of the cures, there being 94 cases of recurrent and residual tumour. Pseudomucinous carcinoma was not significantly distinguished from serous carcinoma. The ratio of cured to operable cases 21 to 44 or 47.7±7.5% is not significantly different from those already listed. Technical data: 50 cm. FSD, 0.75 mm.cu and 2 mm. A<sub>2</sub> filtration, 4 fields each 15 cm. square, 5 treatments to all fields of 300-360r each, total 1500-1800r to each field. Assuming 40% depth dose and 1.3 back-scatter factor the tumour dose is roughly 1800r in 5 treatments for what the authors designate adequate treatment. The inadequate treatment used in their earliest experience during 1931 to 1933 was a single session 670r to each of 4 fields, 20 cm. square, the tumour dose thus being about 900r, probably, on the same assumptions.

No.2, Campbell and Singman (1947) reported the results of operative treatment in 63 cases, about half of whom received XRay treatment in addition to operation. They had only 13% success at five years. No significant difference in result was shown between solid and cystic carcinoma. Unilateral and bilateral carcinoma were also not significantly different.

No.12, Marchetti (1941) reported one successful case among 20 treated by operation and 200 KV XRay therapy. Technical data: 1 mm.cu and 1 mm. A<sub>2</sub> filter, 4 to 6 portals each 150-225 sq.cm.,

200r in aid daily to two areas until 1800-2400r. Assuming 40% depth dose and 1.3 back scatter factor the tumour dose is probably 400r in a week or so.

## Conclusions.

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Inspection of the tables showing methods of treatment and their results reveals no consistent advantage in the employment of any one method.

Comparison between those treated by operation and those treated by the addition of XRay therapy to operation is given in two series. In No.14, Meigs (1940) found that the cases treated by XRay therapy had worse results. In No,22, Taylor and Greeley (1942) showed that adequate XRay treatment raised the percentage cures from 14.6 to 34.6, but this difference just fails to be significant; however, inadequate XRay treatment, given after operation, was associated with significantly worse results than operation alone.

Twelve series give, as a separate class, the results in early, operable cases, without metastases. The range of values is from 40<sup>†</sup>12.65% to 79<sup>†</sup>9.35% therefore none is significantly different from 60% cured at five years.

The table comparing cases of carcinoma, confined to one ovary, with cases of carcinoma, confined to the two ovaries, shows no difference of significance in the results of treatment, either by operation only, by operation with XRay following or by operation with postoperative XRay and Radium therapy.

From the recorded details of treatment in the literature it is possible to make 78 valid comparisons but, on statistical analysis, only 29 reveal significant differences. Eleven of the series contain the significant conclusions.

(a) Early cases where operation can be complete are shown by authors No.1, 3, 4, 5, 7, 16, 19, 22, 24, 25 to have a much better prognosis than advanced cases, as would be expected. Abdominal metastases give a worse prognosis than pelvic extension of growth (Nos.1, 25), carcinoma confined to one ovary is less serious than pelvic extension No.25). Pelvic extension is worse than carcinoma in the two ovaries only (No.16).

(b) Pseudomucinous cystadenocarcinoma is much less dangerous to life than undifferentiated carcinoma (No.1) or serous (papillary) cystadenocarcinoma (Nos.16, 21). Undifferentiated carcinoma is worse than serous (No.16).

(c) Histological grading shows that highly differentiated adenocarcinoma is associated with a better prognosis than the moderately differentiated and the anaplastic carcinoma (No.21).

(d) Treated cases where no biopsy has been obtained are found to have a worse prognosis than cases of section-proven adenocarcinoma (No.19).

(e) Solid tumours have a worse significance than cystic (No.21.)

(f) In women after the menopause there were fewer good results than in those still subject to menstruation (No.1.)

(g) Cases of growth, recurrent or residual after operation, received benefit from the addition of XRay and Radium treatment (No.4).

(h) Among cases treated only by operation supravaginal hysterectomy was a decidedly advantageous addition to oophorectomy (No.1).

Distribution of cases in the Liverpool series.  
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As shown in table A, record-sheets of 450 cases, registered from 1944 onwards as malignant disease of the ovary, were examined. Of these 33 were excluded from analysis because in 21 the first operation on the ovary was performed prior to 1944 and, in the other 12, the cancer was not primary. Case-records of 417 cases were thus available for a study of all cases in the Liverpool region, who were admitted to hospital suffering from ovarian primary cancer. Those who died at home are not included but it is probable that nearly all cases are sent to hospital for diagnosis. For a population of 2 million the expected incidence of cancer of the ovary is about 100 cases in a year (The Registrar General, 1949) but it was shown by Stocks (1947) that Liverpool had in the years 1921-30 an incidence of only 73% of the average for England and Wales.

The proportions in the pathological classes were fairly constant each year as seen in table B. Adenocarcinoma provided 57% of all, carcinoma simplex 19%, there was only a clinical diagnosis in 18%, 6% were sarcoma, malignant teratoma, squamous carcinoma, granulosa cell tumour and dysgerminoma respectively. The important group numerically is carcinoma, which includes over three-quarters of the cases of cancer registered.

The distribution of cystic and solid tumours in the different pathological groups of adenocarcinoma is shown in table C. It is found that only the solid tumours show a significant differ-

ence, from the average, in their low proportion of early cases. Whereas the average percentage of early cases is  $38 \pm 3.5\%$  the solid tumours have only  $18 \pm 6.15\%$  in early stages.

Carcinoma simplex is analysed in table D but the total number of cases is only 81, therefore statistical differences are not significant, except between cystic and solid types. Cystic tumours show  $31 \pm 8.6\%$  early cases while solid tumours are early in only  $9.5 \pm 6.4\%$  cases. The average is  $21 \pm 4.54\%$  of early cases, which is only about half the percentage found in adenocarcinoma, a significant difference.

From an inspection of table E, it is seen that the average age is just over 50 years, for adenocarcinoma and for carcinoma simplex, and that the length of history of symptoms is about half a year, in each type. The length of history is not definitely related to the type or stage or to the method of treatment. It is probable that the symptoms of pain and swelling, which usually characterize this disease, are due to a critical volume of growth, rather than invasion of tissues: result from pressure and are not caused by interference with the function of the malignant ovary.

MILLER (1948) stated that ovarian cancer formed 10-20% of ovarian tumours and that the average age was 52 years. BAYLY and GREENE (1949) believe that non-hormone producing ovarian neoplasms per se rarely, if ever, cause abnormal uterine bleeding; another cause is present in almost all bleeding occurring in the presence of this type of tumour.

GAGNER and SJÖVALL (1949) investigated the frequency of malignant tumours among 2680 ovarian and parovarian tumours from the

Pathological Institute in Lund, collected over 50 years, their figures being shown below:-

Year groups	0-15	16-30	31-45	46-60	61-75	79-90
% malignant	38 $\pm$ 7.7	12 $\pm$ 1.5	26 $\pm$ 1.5	40 $\pm$ 1.7	39 $\pm$ 2.4	27 $\pm$ 8.1

They state that the difference between age groups 0-15 and 16-30 years, 26 $\pm$ 7.8%, is statistically certain. It can be seen by inspection that, over 45 years of age and in childhood, nearly half the ovarian tumours examined were malignant, but during the reproductive period less than a quarter. Only 39 cases out of the 2680 tumours occurred in childhood.

The proportion of cases who received radiotherapy in each year from 1944 to 1949 inclusive, shown in table F, ranged from 4 to 6% of the grand total. The proportion of cases treated only by operation increased after the first two years, more surgeons cooperating in the registration scheme in these later years. In the year 1949, the ratio of radiotherapy-treated to purely operative cases was 27 to 100.

In the different pathological classes the ratio of those receiving radiotherapy to those treated solely by operation was 68% for early stages of adenocarcinoma, 58% for the late stages, 40% for carcinoma simplex, 32% for various other types of malignant disease and only 12% of the cases without pathological diagnosis. It can be seen that those patients receive radiotherapy

who survive the operative treatment and are in good general condition whereas those unfit for operation are usually unfit for radiotherapy.

## Inferences from the Liverpool series.

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From the percentage of survivals each year after treatment, an attempt has been made to compare the results of operation, combined with XRay treatment, and the results of purely operative treatment.

Early stages and late stages, cystic and solid tumours, respectively, have been separately considered, the cases being grouped according to the pathological classification on histological examination.

Adenocarcinoma in early stages, that is, confined to one ovary or to the two ovaries, is shown in table G. No significant difference at three years interval was found. Only 16 cases could have lived 5 years but seven were in fact alive and well, a percentage of 44 of all treated by any method.

Adenocarcinoma in late stages shows in table H a significant improvement in the number alive and well, one year after treatment by combined radiotherapy and operation, compared with treatment by operation only.

Two years after treatment the survivors who had received radiotherapy are significantly more in number than those who were treated only by operation. Significant differences were not observed when solid tumours were separately considered but their outlook was poor. Three years after operation few survived, whereas, among the cases who received the addition of radiotherapy there remained alive 25±9.7% of 20 cases of cystic tumour, but

this is not a significant difference. Only one patient out of 100 cases lived four years after operation, none of the 46 cases given radiotherapy lived four years, no case was free of growth at the end of four years. Even the exclusion of those patients who died within two months of operation, on the grounds that they could not have been subjected to radiotherapeutic measures, does not improve the figures of operative treatment sufficiently to warrant the omission of post-operative radiotherapy in routine treatment.

Carcinoma simplex provides in table I, numbers which are too small for proper comparison, there being only 23 cases treated by operation and radiotherapy. Of the 81 cases treated, in total, only 14 survived one year, only 9 out of 45 survived three years and, at five years from treatment, the only 3 survivors were among those 7 who had received radiotherapy, out of a group of 19 cases.

A dose of 3000r at the tumour in 28 days, given by four fields each 20 x 10 cm., at 50 cm. FSD, arranged round the lower abdomen and pelvis, using 200-240 KV, HVL 1.5 to 2 mm.cu, treating each area 5 days a week for 20 sessions was the routine method and was borne well by patients. Blood counts did not show dangerous effects on the bone marrow whereas the large-field "abdominal bath" technique used in 1950 on some cases produced a serious fall, as is seen in table J. The skin dose was not allowed to exceed 4000r with back-scatter but was a limiting factor only in very stout women.

## Conclusions.

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Radiotherapy does no harm as a post-operative supplement to an operation which completely removes cancer of the ovary. It should be given as a routine after every operation on ovarian cancer, because there is good evidence that radiotherapy is a valuable complement to an operation which removes only part of the ovarian tumour.

XRay apparatus of the usual 200 KV type with HVL 2mm copper provides sufficient depth dose at the tumour when 4 fields each 20 x 10 cm. at 50 cm. FSD are employed. A dose of 3000r at the tumour in 28 days can be obtained, without permanent skin damage and without risk to the blood-forming organs.

## S U M M A R Y .

An analysis of the medical records of women suffering from ovarian malignant tumours who were registered at the Clinical Registry, Radium Institute Annexe, 36 Rodney Street, Liverpool, Lancashire, England in the six years 1944 - 1949 inclusive, has been made during 1950 and 1951. The cases have been grouped to select primary malignant tumours in which the first diagnosis was made during the period 1944 - 1949, cases of carcinoma being subjected to special study.

The literature on the subject published from 1940 onwards has been studied in the original. The results given have been checked, analysed and tested for statistical significance.

## A P P E N D I X .

A. Staging.

B. Tables.

C. Calculation of the Correlation Coefficient.

D. Tests of significance.

## A P P E N D I X A.

### The Clinical Staging of Ovarian Cancer.

In this survey:-

#### Early Cases

- Stage I means apparently confined to one ovary.  
Stage II means confined to the two ovaries.

#### Late Cases

- Stage III means spread to adjacent organs but capable of being treated by radical excision.  
State IV means fixed to the pelvis and incapable of radical excision. Distant metastasis would be included but is rare.

In 40 cases of ovarian cancer Norris and Murphy (1932) found, on microscopic examination of the ovaries after bilateral oöphorectomy, that in 33 cases both microscopic and macroscopic evidence of cancer was present in each ovary, but that the remaining 7 cases had one ovary, apparently benign, which was invaded on microscopic examination for cancer.

This observation may explain the similarity of the progress of Stage I and Stage II cases. There is also the lesson that unilateral oöphorectomy is unlikely to be successful in preventing "recurrence" in the second ovary which is probably already microscopically invaded at the time of operation.

Lynch and Dockerty (1945) explain the spread of cancer from one ovary to the other and to the uterus by the intercommunication between lymphatic drainage. They found at the Mayo Clinic in 11½ years, 1929 to 1940, a total of 113 cases showing spread either from uterine to ovarian or from ovarian to uterine sites. Of ovarian cancers 6% led to endometrial metastasis and, of fundus carcinoma in an operable state, 4% had metastasis in the ovary.

A P P E N D I X B.

List of Tables.

- A. Distribution of cases of ovarian cancer in the Liverpool series.
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  - C. Distribution of cystic and solid adenocarcinoma on initial staging.
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- 
- 1. List of authors in the literature.
  - 2. Percentages of cases alive and well five years in the literature.
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TABLE A.

Distribution of cases of ovarian cancer in the Liverpool series.

Cases registered in the years 1944 to 1949 inclusive	447
Cases whose operation was in 1949 registered in 1950	3
Total number of cases	<u>450</u>
Cases diagnosed before 1944, treated by operation only	<u>14</u>
Cases diagnosed before 1944, given radiotherapy	7
Cases not primary cancer	12
Number of cases of primary cancer of ovary first diagnosed in the years 1944 - 1949 inclusive	<u><u>417</u></u>

TABLE B.

Number of cases in each Pathological class by years.

	1944	1945	1946	1947	1948	1949	Total	%
Adenocarcinoma	24	25	43	48	47	50	237	57
Carcinoma simplex	14	5	11	15	20	16	81	19
No pathological diagnosis	13	5	12	20	14	10	74	18
Various malignant diseases	3	2	5	3	8	4	25	6
	<u>54</u>	<u>37</u>	<u>71</u>	<u>86</u>	<u>89</u>	<u>80</u>	<u>417</u>	<u>100</u>

TABLE C.

Distribution of cystic and solid adenocarcinoma on initial staging.

STAGE.	TOTAL. CYSTIC.	PSEUDO-MUCINOUS CYST.	PAP. CYST.	SOLID. UNCLASSIFIED.
Early Percentages	91 100	11 12	33 36	7 8
Late Percentages	146 100	8 6	51 35	32 22
All stages Percentages	237 100	19 8	84 36	39 16

Percentage of each type in early and late stages.

Early	38	48	58	39	18	25
Late	62	52	42	61	82	75
(a) S.D. of %	3.5	5.9	11.3	5.8	6.15	8.85
(b) S.E. of diff.		6.7	11.75	6.2	6.9	9.4
Diff. / (b)		1.5	1.7	0.16	2.9	1.4

TABLE. D.

Distribution of cystic and solid carcinoma simplex on initial staging.

STAGE.	TOTAL.	CYSTIC.	SOLID.	UNCLASSIFIED.
Early	17	9	2	6
Percentages	100	53	12	35
Late	64	20	19	25
Percentages	100	31	30	39
All stages	81	29	21	31
Percentages	100	36	26	38

Percentage of each type in early and late stages.

Early	21	31	9.5	19
Late	79	69	90.5	81
(a) S.D. of %	4.54	8.6	6.4	7.05
(b) S.E. of diff. between cystic and solid types is 10.7				
Diff./ (b) is 2.1.				

TABLE E.

For different tumours.

The average age at time of first diagnosis and the average number of months history of illness.

	<u>AGE.</u>	<u>HISTORY.</u>
<u>Adenocarcinoma all stages</u>	52	6
<u>Early adenocarcinoma</u>	50	7
(a) treated by operation only, Stage 1	52	5
- ditto - Stage 2	52	6
(b) treated by operation, radiotherapy given, later than three months after, to recurrent tumour		
Stage 1	53	4
- ditto -(only 2 cases)Stage 2	54	24
(c) treated by operation and radiotherapy, given within three months		
Stage 1	47	7
- ditto -(only 6 cases)Stage 2	47	14
<u>Late adenocarcinoma</u>	53	6
(a) treated by operation only, Stage 3	54	6
- ditto - Stage 4	53	6
(b) treated by operation and radiotherapy,		
Stage 3	51	6
- ditto - Stage 4	52	5
<u>Carcinoma simplex all stages.</u>	54	5
(a) treated by operation only		
Early stage	56	8
- ditto - Late stage	54	5
(b) treated by operation and radiotherapy,		
Early stage	59	5
- ditto - Late stage	51	4

TABLE F.

Percentages of total number of cases treated by Radiotherapy.

METHOD.	Year	Year	Year	Year	Year	Year	TOTAL.
	1944	1945	1946	1947	1948	1949	
(a) Radiotherapy	5	4	6	6	5	4	30
(b) Operation only	8	5	12	14	16	15	70
Ratio (a) to (b)	69	85	48	48	29	27	44

TABLE G.

Annual Survival Rates, alive and well, of cystic and solid tumours in early stages of adenocarcinoma.

Three years 1944 - 47 cases.

	<u>CYSTIC.</u>	<u>SOLID.</u>	Proportion. Percentage.	Proportion. Percentage.
(a) treated by operation only	11/20	55 ± 11.1	1/1	100
(b) treated by operation, radiotherapy later to recurrence	2/6	33	0/4	0
(c) treated by operation and radiotherapy	8/17	47	3/4	75

Five years 1944 - 45 cases.

- (a) treated by operation only combined cyst and solid 1/6.
- (b) treated by operation and radiotherapy 6/10.
- (a) and (b) 7/16 = 44%.

TABLE H.  
Annual Survival Rates of cystic and solid tumours in late stages of Adenocarcinoma.

	<u>CYSTIC.</u>		<u>SOLID.</u>	
	<u>Proportion</u>	<u>Percentage</u>	<u>Proportion</u>	<u>Percentage</u>
<u>One Year alive and well, 1944-49 cases.</u>				
(a) treated by operation only	5/64	7.8±3.4	0/36	0
(b) treated by operation lived over three months	5/34	10.9±5.4	0/19	0
(c) treated by operation and radiotherapy	17/32	53.2±8.8	4/14	29.6±12.2
Differences from (c) significant.				
<u>Two years alive, 1944-48 cases.</u>				
(a) treated by operation only	6/48	12.5±4.8	1/30	3.3±3.3
(b) treated by operation lived over two months	6/35	17.1±6.4	1/20	5
(c) treated by operation lived over three months	6/24	25 ± 8.8	1 /15	6.6
(d) treated by operation and radiotherapy	10/25	40 ± 9.8	3/12	25 ±12.5
Differences (a) and (d) has Variance = 118.8, S.D.=±10.9, diff. 27.5/10.9 = 2.52, P =0.012 significant.				
Differences (b) and (d) has Variance = 136.5, S.D.=±11.7, diff.22.9/11.7 = 1.96, P =0.05 significant.				
Difference (c) and (d) not significant.				
<u>Three years alive, 1944-47 cases.</u>				
(a) treated by operation only	2/34	5.9± 4	0/24	0
(b) treated by operation lived two months	2/24	8.3± 5.2	0/16	0
(c) treated by operation liver over three months	2/16	12.5± 8.3	0/12	0
(d) treated by operation and radiotherapy	5/20	25 ± 9.7	2/10	20 ± 12.7
Difference from (d) not significant.				

TABLE I.

Annual Survival Rates of carcinoma simplex.

Survivors alive and well one year, 1944 - 49 cases.

Early Stage.

- (a) treated by operation only  $4/9 = 44.4 \pm 16.6\%$
- (b) treated by operation and radiotherapy  $8/8 = 100\%$

Late Stage.

- (a) treated by operation only 0/49
- (b) treated by operation and radiotherapy  $2/15 = 13.3 \pm 8.8$

TOTAL  $14/81 = 17\%$  alive and well.

Survivors alive three years, 1944 - 47 cases.

Early Stage.

- (a) 0/3
- (b)  $6/7 = 85.7 \pm 13.2$

Late Stage.

- (a)  $2/24 = 8.3 \pm 5.6\%$
- (b)  $1/11 = 9.1 \pm 8.7\%$

TOTAL  $9/45 = 20\%$  alive.

Survivors alive five years, 1944 - 45 cases.

- (a) 0/12
- (b) 3/7

TOTAL  $3/19 = 16\%$  alive.

TABLE J.

The drop in the leucocyte count of the blood of patients undergoing 200 KV X-ray treatment to the pelvis and lower abdomen compared with that found after widefield "abdominal bath" X-ray therapy, in cases treated during the year 1950.

<u>Duration of course in days.</u>	<u>Number of Sessions.</u>	<u>Percentage drop in W.B.D.</u>	<u>Age in years.</u>	<u>Size of fields in Cm.</u>	<u>Number of fields</u>
28	20	nil	49	25 x 10	4
9	7	25	19	25 x 10	4
28	20	49	20	20 x 10	4
28	20	38	67	20 x 10	4
28	20	28	51	20 x 10	4
28	20	24	53	20 x 10	4

Note that no case treated by 20 x 10 Cm. fields shows a drop of more than 50% of the initial White cell count.

28	20	63	44	40 x 30	2
28	20	54	49	40 x 30	2
25	17	74	60	40 x 30	2
21	15	80	63	40 x 30	2
28	20	58	45	40 x 30	2
28	20	56	48	40 x 30	2
28	20	40	59	30 x 20	2
29	20	65	39	40x 30	2
16	12	61	62	40 x 30	2
25	17	71	44	40 x 30	2

Note that every case treated by 40 x 30 Cm. fields shows a drop of more than 50% of the White cell count.

## SURVEY OF THE LITERATURE.

### TABLE 1.

The papers of the last ten years or so, 1940 - 1950, have been arranged according to the author's name in alphabetical order. A serial number has been given as a short reference. The hospital, the inclusive period of the investigation and the number of cases of primary carcinoma of the ovary are listed.

AUTHORS.	HOSPITALS.	YEARS SURVEYED.	NUMBER of CASES.
1. Allan and Hertig(1949) includes Pemberton (1940)	Free Hospital for Women, Brookline, Mass.U.S.A.  Free Hospital for Women, Boston, Mass. U.S.A.	1903-1945  1906-1938	265
2. Campbell and Singman (1947)	Highland Alameda County Hospital, California, U.S.A.	1930-1941	63
3. Diddle (1949)	S.W. Medical College, Dallas, Texas, U.S.A.	1936-1946	108
4. Ellis (1944)	Sheffield Radium Centre, England.	1932-1939	105
5. Freed and Pendergrass (1948)	University of Pennsylvania, Philadelphia, Pa., U.S.A.	1930-1941	84
6. Helsel (1946)	University of Pittsburgh, Pennsylvania, U.S.A.	1929-1943	92
7. Heyman(1930)	Radium hemmet, Stockholm, Sweden.	to 1930	67
8. Holmes and Schulz(1946)	Memorial Hospital, Massachusetts, U.S. A.	1937-1944	25
9. Jones (1941)	Guthrie Clinic and Robert Parker Hospital, U.S.A.	1927-1939	30
10.Kerr and Einstein(1945)	University of Iowa, U.S.A.	1930-1938	95
11.Leucutia(1947)	Harper Hospital, Detroit, Michigan, U.S.A.	1923-1940	242
12.Marchetti(1941)	The New York Hospital, U.S.A.	1932-1940	20
13.Marks and Wittenborg (1948)	New England Deaconess Hospital, Boston, Mass.U.S.A.	1936-1946	76

AUTHORS.	HOSPITAL.	YEARS SURVEYED.	NUMBER of CASES.
14.Meigs (1940)	Massachusetts General Hospital, Boston,Mass.U.S.A.	1901-1934	154
15.Montgomery (1948)	Jefferson Hospital, Philadelphia,Pennsylvania,USA.	1921-1946	68
16.Munnell and Taylor(1949)	Sloane Hospital for Women, New York, U.S.A.	1922-1943	200
17.Norris and Murphy(1932)	University of Pennsylvania, Philadelphia,Pa., U.S.A.	to 1928	1 25
18.O'Donoghue(1949)	St.Vincent's Hospital, Melbourne, Australia.	1927-1947	75
19.Paterson,Tod and Russell (1950)	Radium Institute,Manchester, England.	1940-1944	153
20.Swinton and Yancey(1947)	The Lahey Clinic, U.S.A.	1932-1942	45
21.Taylor (1950)	Birmingham Hospital for Women, England.	1939-1948	161
22.Taylor and Greeley(1942)	Roosevelt Hospital, New York, U.S.A.	1910-1935	138
23.Walter, Bachman and Harris (1941)	Mt.Sinai Hospital, New York, U.S.A.	1928-1935	153
24.Wetterdal (1949)	Sabbatsberg Hospital, Stockholm, Sweden.	1920-1946	182
25.Williams (1944)	Middlesex and Mount Vernon Hospitals, London,England.	(unstated)	248

The published reports of the last ten years or so make up a total of twentyfive series surveying 2974 cases extending over the first half of the twentieth century. The smallest series comprises 30 cases, the largest 265; Only four series contain 200 or more cases, nine have between 100 and 200 cases, while twelve record less than a hundred cases each.

TABLE 2.

Percentages of cases alive and well five years after treatment of primary carcinoma of the ovary by various methods, reported in the literature.

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
1.	83/239 treated 83/265 seen; treated and untreated	34.8 31.3	9.5 8.12	3.08 2.85	29 - 41 26 - 37
(a)	44/154 Treated by operation only 39/85 treated by operation and X-ray 17.3/6.52 = 2.6, P = 0.01 Difference	28.6 45.9 17.3	13.25 29.2 42.45	3.64 5.4 6.52	21 - 36 35 - 57 Significant
(b)	51/143 treated serous cystadenocarcinoma 24/51 Treated pseudo mucinous carcinoma 11.5/8.06 = 1.43, P = 0.14 Difference	35.6 47.1 11.5	16.1 48.8 64.9	4.01 6.99 8.06	28 - 44 33 - 61 not significant
	4/22 treated undifferentiated carcinoma 24/51 treated pseudomucinous carcinoma 28.9/10.8 = 2.68, P = 0.008 Difference	18.2 47.1 28.9	67.7 48.8 116.5	8.23 6.99 10.8	2 - 35 33 - 61 significant
	51/143 treated serous cystadenocarcinoma 4/22 treated undifferentiated carcinoma 17.4/9.15 = 1.9, P = 0.06 Difference	35.6 18.2 17.4	16.1 67.7 83.8	4.01 8.23 9.15	28 - 44 2 - 35 not significant
(c)	26/124 treated, metastases present at operation 57/115 treated, no metastases at operation 28.5/5.92 = 4.8, P = less than 0.0002 Difference	21 49.5 28.5	13.35 21.7 35.05	3.65 4.66 5.92	14 - 28 40 - 59 significant
(d)	1/12 treated by exploration, some with biopsy 0/6 treated by exploration, biopsy, X-ray 8.33/13.8 = 0.6, P = 0.54 Difference	8.33 0 8.33	63.5 127 190.5	7.97 11.27 13.8	0 - 24 0 - 23 not significant
	5/38 treated by oophorectomy 5/15 treated by oophorectomy and X-ray 20.18/13.34 = 1.5, P = 0.13 Difference	13.15 33.33 20.18	30.1 148 178.1	5.49 12.16 13.34	2 - 24 9 - 58 not significant

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
1.					
(d) Cont.	34/89 treated by supravaginal hyst.+obph.	38.2	26.5	5.15	28 - 48
	23/47 treated also by X-ray	49	53.2	7.29	34 - 64
	10.8/8.93 = 1.2, P = 0.22 Difference	10.8	79.7	8.93	not significant
	4/15 treated by complete hyst.+ obph.	26.6	130	11.4	4 - 49
	11/17 treated also by X-ray	64.7	134	11.58	42 - 88
	38.1/16.25 = 2.3, P = 0.02 Difference	38.1	264	16.25	not significant
(e)	1/12 treated by exploration, biopsy	8.33	63.5	7.97	0 - 24
	5/38 treated by obphorectomy	13.15	30.1	5.49	2 - 24
	4.82/9.67 = 0.5, P = 0.62 Difference	4.82	93.6	9.67	not significant
	0/6 treated by exploration, biopsy, X-ray	0	127	11.27	0 - 23
	5/15 treated by obphorectomy and X-ray	33.33	148	12.16	9 - 58
	33.33/16.58 = 2, P = 0.05 Difference	33.33	275	16.58	not significant
	5/38 treated by obphorectomy	13.15	30.1	5.49	2 - 24
	34/89 treated by supravaginal hyst.+obph.	38.2	26.5	5.15	28 - 48
	25.05/7.52 = 3.3, P = 0.001 Difference	25.05	56.6	7.52	significant
	5/15 treated by obphorectomy and X-ray	33.33	148	12.16	9 - 58
	23/47 treated by supravaginal hyst.+ X-ray	49	53.2	7.29	34 - 64
	15.67/14.2 = 1.1 P = 0.26 Difference	15.67	201.2	14.2	not significant
	34/89 treated by supravaginal hyst.+obph.	38.2	26.5	5.15	28 - 48
	4/15 treated by complete hysterectomy+ obph.	26.6	130	11.4	4 - 49
	11.6/12.51 = 0.9, P = 0.36 Difference	11.6	156.5	12.51	not significant
	23/47 treated by supravaginal op. + X-ray	49	53.2	7.29	34 - 64
	11/17 treated by complete operation + X-ray	64.7	134	11.58	42 - 88
	15.7/13.68 = 1.1, P = 0.26 Difference	15.7	187.2	13.68	not significant

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
1. (f)	31/154 treated by op. only survived ten years	20	10.4	3.22	14 - 26
	30/85 treated by op.+ X-ray survived ten yrs.	36	27.1	5.21	26 - 46
	16/6.12 = 2.6, P = 0.01 Difference	16	37.5	6.12	significant
	22/155 treated by op. only survived 15 years	14	7.82	2.8	8 - 20
	12/85 treated by op.+ X-ray survived 15 yrs.	14	14.15	3.76	6 - 22
(g)	41/99 treated, premenopausal	43	24.8	4.98	33 - 53
	42/150 treated, post-menopausal	28	13.4	3.66	21 - 35
	15/6.18 = 2.4, P = 0.016 Difference	15	38.2	6.18	significant
NOTE: Only round number percentages were given by Author in (f) and (g).					
2.	8/63 treated, about half had X-ray also, by op.	12.7	17.6	4.2	4 - 21
	5/53 treated, cystic carcinoma	9.45	16.1	4.01	1 - 17
	3/10 treated, solid carcinoma	30	210	14.5	1. - 59
	20.55/15.04 = 1.4, P = 0.16 Difference	20.55	226.1	15.04	not significant
	3/20 treated unilateral cystic carcinoma	15	63.8	7.99	0 - 31
	2/31 treated bilateral cystic carcinoma	6.45	19.5	4.4	0 - 15
	8.55/9.13 = 0.9, P = 0.36 Difference	8.55	88.3	9.13	not significant
3.	23/108 treated by operation, complete and other	21.3	15.5	3.94	13 - 29
	15/20 completely cleared of carcinoma	75	93.75	9.68	56 - 94
	53.7/10.45 = 5.1, P less than 0.0002 Difference	53.7	109.25	10.45	significant
4.	19/105 treated by operation+Radium+X-ray	18.1	14.1	3.75	11 - 26
	21/105 alive and well 3 yrs after treatment	20	15.2	3.9	12 - 28
	17/25 treated by complete operation+Ra.+X-ray	68	87	9.33	49 - 87
	11/51 treated by incomplete op.+Radium+X-ray	21.6	33.2	5.76	10 - 34
	46.4/10.96 = 4.2, P less than 0.0002 Difference	46.4	120.2	10.96	significant

NOTE: 3 year results.

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
4.	1/20 untreated cases with definite recurrence or residue	5	23.75	4.87	0 - 15
	15/68 treated cases with definite recurrence or residue	22.1	25.3	5.03	12 - 32
	17.1/7 = 2.4, P = 0.016 Difference	17.1	49.05	7.	significant
	NOTE: 3 year results.				
5.	33/84 treated by operation and X-ray, all stages	39.3	28.4	5.33	29 - 50
	15/21 early stage treated by op. + X-ray	71.5	97	9.85	52 - 91
	18/63 late stage treated by op. + X-ray	28.6	32.4	5.69	17 - 40
	42.9/11.38 = 3.8, P less than 0.0002 Difference	42.9	129.4	11.38	significant.
6.	4/92 sean	4.35	4.52	2.12	0 - 9
	4/57 traced, treated by op.+ X-ray	7	11.4	3.38	0 - 14
7.	19/27 unilateral, treated by op.+X-ray + Ra.	70.5	77	8.78	63 - 88
	2/5 bilateral, treated by op. + X-ray+ Ra.	40	480	21.9	0 - 84
	30.5/23.6 = 1.3, P = 0.19 Difference	30.5	557	23.6	not significant.
	21/32 early, treated by op. + X-ray + Ra.	65.6	70.6	8.4	49 - 82
	7/30 late, post-op. residual, treated	23.3	59.5	7.7	8 - 39
	42.3/11.4 = 3.7, P = 0.0002 Difference	42.3	130.1	11.4	significant
8.	6/25 treated by op. and 1000 KV. X-ray	24	72.9	8.54	7 - 41
9.	7/30 treated by op. and X-ray 200 KV.	23.3	59.5	7.7	8. - 39
10.	38/95 treated by op. and X-ray, 75% late	40	25.2	5.02	30 - 50

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
11.	24/140 treated by operation and 200KVP.X-ray	17.1	10.1	3.18	11 - 24
	12/52 treated by operation and 500KVP.X-ray	23.1	34.1	5.83	11 - 35
	6/6.65 = 0.9, P = 0.36				
	Each series up to year 1937. Difference	6	44.2	6.65	not significant
	16/50 treated by op.+ 500KVCP X-ray,1938-1940	32	43.5	6.6	19 - 45
	24/140 treated by op.+ 200KVP X-ray,1923-1937	17.1	10.1	3.18	11 - 24
	14.9/7.32 * 2.04, P = 0.04 Difference	14.9	53.6	7.32	significant
12.	1/20 treated by op. + X-ray 200 KV	5	23.75	4.87	0 - 15
13.	14/66 treated by op. + X-ray 400KV, 5 year survivors	21.2	25.3	5.03	11 - 31
	13/66 treated, apparently cured at 5 yrs.	19.7	24.	4.9	10 - 30
14	25/154 treated by operation,with X-ray in 64 cases	16.2	8.8	2.97	10 - 22
(a)	5/40 treated by operation only, solid Ca.	12.5	27.4	5.24	2 - 23
	2/32 treated by op. + HVX, solid ca.	6.25	18.3	4.28	0 - 15
	6.25/6.76 = 0.9, P = 0.36 Difference	6.25	45.7	6.76	not significant
	12/50 treated by operation only, cystic ca.	24	36.4	6.03	12 - 36
	6/32 treated by op.+ HVX, Cystic ca.	18.75	47.6	6.9	5 - 33
	5.25/9.16 = 0.5, P = 0.62 Difference	5.25	84	9.16	not significant
(b)	5/40 treated by operation only, solid Ca.	12.5	27.4	5.24	2 - 23
	12/50 treated by operation only, cystic Ca.	24	36.4	6.03	12 - 36
	11.5/7.99 = 1.4, P = 0.16 Difference	11.5	63.8	7.99	not significant
	2/32 treated by op. + HVX, solid Ca.	6.25	18.3	4.28	0 - 15
	6/32 treated by op. + HVX, cystic Ca.	18.75	47.6	6.9	5. - 33
	12.5/8.12 = 1.5, P = 0.14 Difference	12.5	65.9	8.12	not significant.

Author.	Proportion	Percentage.	Variance.	Standard Deviation.	Probable Range.	
15.	14/68 treated by operation+ X-ray	20.6	24	4.9	11 - 30	
16.	55/200 treated by operation + X-ray	27.5	9.96	3.16	21 - 34	
	55/178 treated, section proved	30.9	12	3.46	24 - 38	
(a)	38/125 treated, serous cystadenocarcinoma	30.4	16.9	4.11	22 - 39	
	9/15 treated, pseudomucinous Ca.	60	160	12.65	35 - 85	
	29.6/13.3 = 2.2, P = 0.028 Difference	29.6	176.9	13.3	significant	
(b)	38/125 treated serous cystadenocarcinoma	30.4	16.9	4.11	22 - 39	
	0/22 treated undifferentiated Ca.	0	90.6	9.52	0 - 19	
	30.4/10.4 = 2.92, P= 0.004 Difference	30.4	107.6	10.4	significant	
(b)	30/51 treated, stage I, section proved	58.8	47.5	6.89	45 - 73	
	16/20 treated, stage II, section proved	80	80	8.94	62 - 98	
	21.2/11.29 = 1.9, P= 0.06 Difference	21.2	127.5	11.29	not significant	
16/20 treated, Stage II, section proved	5/25 treated, Stage III, section proved	60/12 = 5, P less than 0.0002 Difference	80	80	8.94	62 - 98
			20	64	8	4 - 36
			60	144	12	significant
5/25 treated, StageIII, section proved	4/82 treated, Stage IV, section proved	15.12/8.35 = 1.8, P = 0.07 Difference	20	64	8	4 - 36
			4.88	5.66	2.38	0 - 10
			15.12	69.66	8.35	not significant.
46/71 treated early cases section proved	9/107 treated late cases section proved	56.4/6.27 = 9, P less than 0.0002 Difference	64.8	32.1	5.67	53 - 76
			8.4	7.2	2.68	3 - 14
			56.4	39.3	6.27	significant

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.		
17.	50/93	treated by operation, traced 3 yrs.	53.8	26.7	5.17	43 - 64	
	50/125	treated by operation, including untraced	40	19.2	4.38	31 - 49	
	36/56	treated, unilateral carcinoma, 3 yrs.	64.3	41	6.4	52 - 77	
	14/24	treated bilateral carcinoma, 3 yrs.	58.33	101	10.05	38 - 78	
	6/11.9	P = 0.62 Difference	6	142	11.9	not significant	
	15/44	treated unilateral oöphorectomy	34.1	51.1	7.15	20 - 48	
	15/28	treated bilateral oöphorectomy	53.6	88.8	9.42	35 - 72	
	19.5/11.8	P = 0.1 Difference	19.5	139.9	11.8	not significant	
	12/15	treated no adhesions of ovary	80	106.66	10.3	59 - 100	
	18/32	treated, adhesions of ovary	56.25	77	8.77	39 - 74	
	23.75/13.55	P = 0.08 Difference	23.75	183.66	13.55	not significant	
	18.	7/75	seen, some treated by operation	9.33	11.3	3.36	3 - 16
		7/58	treated by op. including explorations	12.05	18.3	4.28	3 - 21
		7/23	treated by removal of at least an ovary	30.4	92	9.59	11 - 50
		3/7	treated by hysterectomy and oöphorectomy	42.8	350	18.71	5 - 80
		4/16	treated by oöphorectomy only	25	117	10.82	3 - 47
		17/21.6	P = 0.4 Difference	17.8	467	21.6	not significant
4/16		treated by oöphorectomy only	25	117	10.82	3 - 47	
19.	0/35	treated by exploration only	0	24.2	4.92	0 - 10	
	25/11.8	P = 0.036 Difference	25	141.2	11.88	not significant	
	4/16	treated by oöphorectomy only	25	117	10.82	3 - 47	
	0/17	untreated inoperable	0	49.6	7.04	0 - 14	
	25/12.9	P = 0.06 Difference	25	166.6	12.9	not significant	
	38/153	seen	24.8	12.2	3.49	18 - 32	
	38/125	treated by op.+ X-ray abdominal baths	30.4	16.9	4.11	22 - 39	

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
19Contd.	15/19 treated early cases corrected for age	83			
	23/106 treated late cases corrected for age	23			
	38/153 seen, corrected for age	26			
(a)	15/19 treated early cases	79	87.4	9.35	60 - 98
	23/106 treated late cases	21.7	16	4	14 - 30
	57.3/10.69 = 5.4, p less than 0.0002 Difference	57.3	103.4	10.69	significant
	38/153 seen	24.8	12.2	3.49	18. - 34
	23/134 seen excluding early cases	17.15	10.6	3.25	11 - 24
	7.65/4.77 = 1.6, P = 0.1 Difference	7.65	22.8	4.77	not significant
	38/125 treated	30.4	16.9	4.11	22 - 39
	23/106 treated excluding early cases	21.7	16	4	14 - 30
	8.7/5.74 = 1.5, P = 0.13 Difference	8.7	32.9	5.74	not significant
(b)	7/48 treated no biopsy or indeterminate	14.6	26	5.1	4 - 25
	11/27 treated adenocarcinoma	40.7	89.5	9.46	22 - 60
	26.1/10.75 = 2.4, P = 0.016 Difference	26.1	115.5	10.75	Significant
	7/48 treated no biopsy or indeterminate	14.6	26	5.1	4 - 25
	12/27 treated papillary cystadenocarcinoma	44.5	91.5	9.57	25 - 64
	29.9/10.8 = 2.8 P = 0.006 Difference	29.9	117.5	10.8	significant
	12/27 treated papillary cystadenocarcinoma	44.5	91.5	9.57	25 - 64
	11/27 treated adenocarcinoma	40.7	89.5	9.46	22 - 60
	3.8/13.45 = 0.3, P = 0.76 Difference	3.8	181	13.45	not significant
20.	9/45 treated by operation and X-ray	20	35.6	5.97	8 - 32
21.	28/161 treated by operation only, section proved	17.4	8.93	2.99	11 - 23

Author.	Proportion.	Percentage.	Variance	Standard Deviation.	Probable Range.
21.	(a) 21/74 treated cystic carcinoma 7/87 treated solid carcinoma 20.35/6 = 3.4, P = 0.0008 Difference	28.4 8.05 20.55	27.5 8.5 36	5.25 2.92 6	18 - 39 2 - 14 significant
	(b) 19/29 treated grade I histological 8/90 treated grade II histological 56.62/9.33 = 6.1, P less than 0.0002 Difference	65.5 8.88 56.62	78 9 87	8.83 3 9.33	48 - 83 3 - 15 significant
	1/42 treated grade III histological 8/90 treated grade II histological 6.5/3.81 = 1.7, P = 0.1 Difference	2.38 8.88 6.5	5.54 9 14.54	2.35 3 3.81	0 - 7 3 - 15 not significant
	(c) 17/36 treated pseudomucinous carcinoma 9/88 treated serous carcinoma 37/8.93 = 4.1, P less than 0.0002 Difference	47.2 10.2 37	69.4 10.35 79.75	8.33 3.22 8.93	31 - 64 4 - 17 Significant
	1/29 Treated anaplastic carcinoma 9/88 treated serous carcinoma 6.75/4.67 = 1.4, P = 0.16 Difference	3.45 10.2 6.75	11.5 10.35 21.85	3.39 3.22 4.67	0 - 10 4 - 17 not significant
22.	21/138 treated by operation or by op.+ 200 KV X-ray	15.2	9.35	3.06	9 - 21
	(a) 12/82 treated by operation only 9/26 treated by op.+ adequate X-ray 20/10.11 = 1.98, P = 0.05 Difference	14.6 34.6 20	15.2 87 102.2	3.9 9.33 10.11	7 - 22 16 - 53 not significant
	1/30 treated by op. + inadequate X-ray 9/26 treated by op. + adequate X-ray 31.27/9.88 = 3.1, P = 0.002 Difference	3.33 34.6 31.27	10.7 87 97.7	3.27 9.33 9.88	0 - 11 16 - 53 significant

Author.	Proportion.	Percentage.	Variance.	Standard Deviation.	Probable Range.
22.					
(a)	Contd. 12/82 treated by operation only 1/30 treated by op.+ inadequate X-ray 11.27/5.09 = 2.2, P = 0.028 Difference	14.6 3.33 11.27	15.2 10.7 25.9	3.9 3.27 5.09	7 - 22 0 - 10 significant
(b)	20/44 treated operable cases 1/94 treated recurrent and residual 44.44/7.58 = 5.9 P less than 0.0002 Difference	45.5 1.06 44.44	56.4 1.12 57.52	7.51 1.06 7.58	30 - 61 0 - 3 significant
(c)	5/25 treated pseudomucinous carcinoma 9/63 treated serous carcinoma 5.72/9.13 = 0.6, P = 0.54 Difference	20 14.28 5.72	64 19.4 83.4	8 4.4 9.13	4 - 36 5 - 23 not significant
23.	18/124 treated operation or op.+ X-ray 18/153 seen including 14 not treated and 15 op. deaths	14.5 11.75	10 6.78	3.17 2.6	8 - 21 7. - 17
(a)	4/19 treated, operation, early cases 6/15 treated, operation + adequate X-ray early cases 19/15.72 = 1.2, P = 0.22 Difference	21 40 19	87.2 160 247.2	9.34 12.65 15.72	2. - 40 15 - 65 not significant
(b)	0/44 treated, operatio, advanced cases 3/16 treated, op. + adequate X-ray, advanced 18.75/11.11 = 1.7, P = 0.09 Difference	0 18.75 18.75	28.2 95.2 123.4	5.31 9.76 11.11.	0 - 11 0 - 38 not significant
(b)	2/20 treated, op.+ inadequate X-ray 9/31 treated, op.+ adequate X-ray 19/10.55 = 1.8, P = 0.07 Difference	10 29 19	45 66.4 111.4	6.71 8.15 10.55	0 - 23 13 - 45 not significant.
24.	23/84 treated by operation and post op.X-ray 29/145 seen	27.4 20	23.7 11	4.87 3.32	18 - 37 13 - 27

Author.	Proportion.	Percentage.	Variance.	Standard Deviation	Probable Range.
(a)	9/16 treated by complete op. + X-ray	56.25	154	12.4	31 - 81
	9/29 treated by partial op. + X-ray	31	73.7	8.58	14 - 48
	25.25/15.1 = 1.7, P = 0.09 Difference	25.25	227.7	15.1	not significant
5/39 treated by op.+ X-ray, but metastases present	12.8	28.6	5.35	2 - 24	
9/29 treated by partial op.+ X-ray	31	73.7	8.58	14 - 48	
18.2/10.1 = 1.8, P = 0.07 Difference	18.2	102.3	10.1	not significant	
9/16 treated by complete op.+ X-ray	56.25	154	12.4	31 - 81	
5/39 treated by op.+ X-ray, but metastases present	12.8	28.6	5.35	2 - 24	
43.45/13.51 = 3.2, P = 0.0014 Difference	43.45	182.6	13.51	significant	
(B)	0/65 untreated or tapped or only explored	0	24.6	4.96	0 - 10
5/39 treated by op. but metastases present	12.8	28.6	5.35	2 - 24	
12.8/7.29 = 1.8, P = 0.07 Difference	12.8	53.2	7.29	not significant	
25.	38/143 treated, by op. or by op. and X-ray	26.6	13.65	3.69	19 - 34
	38/248 seen, including recurrences	15.3	5.23	2.29	11 - 20
	38/213 seen, previously untreated	17.8	7.2	2.68	12. - 23
(a)	15/23 treated by op.+ X-ray, unilateral Ca.	65.2	98.6	9.93	45 - 85
	6/10 treated by op. only, unilateral Ca.	60	240	15.5	29 - 91
	5.2/18.4 = 0.28, P = 0.78 Difference	5.2	338.6	18.4	not significant
6/17 treated by op.+ X-ray, bilateral Ca.	35.2	134	11.6	12 - 58	
2/9 treated by op. only, bilateral Ca.	22.2	192	13.9	0 - 50	
13/18.05 = 0.7, P = 0.48 Difference	13	326	18.05	not significant	
7/27 treated by op.+ X-ray, pelvic metastases	25.9	71.1	8.43	9 - 43	
0/6 treated by op. only, pelvic metastases	0	216	14.7	0 - 29	
25.9/16.95 = 1.5, P = 0.13 Difference	25.9	287.1	16.95	not significant	

Author.	Proportion.	Percentage.	Variance.	Standard Deviation	Probable Range.
25(b)	2/51 treated by op.+X-ray, abdominal extension	3.92	7.37	2.71	0 - 9
	7/27 treated by op.+X-ray pelvic metastases	25.9	71.1	8.43	9 - 43
	21.98/8.86 = 2.5, P = 0.013 Difference	21.98	78.47	8.86	Significant
(c)	21/40 treated by op.+ X-ray; confined to ovaries	52.5	62.4	7.9	37 - 68
	8/19 treated by op. only; confined to ovaries	42.1	128	11.31	19 - 65
	10.4/13.8 = 0.75, P = 0.42 Difference	10.4	190.4	13.8	not significant
	28/67 treated by op.+X-ray; ovaries and pelvis	41.8	36.3	6.03	30 - 54
(d)	8/25 treated by op. only; ovaries and pelvis	32	87	9.33	13 - 51
	9.8/11.1 = 0.9, P = 0.36 Difference	9.8	123.3	11.1	not significant
	15/23 treated by op.+ X-ray, unilateral Ca.	65.2	98.6	9.93	45 - 85
	6/17 treated by op. + X-ray, bilateral Ca.	35.2	134	11.6	12 - 58
	30/15.25 = 1.9, P = 0.06 Difference	30	232.6	15.25	not significant
	6/10 treated by op. only, unilateral Ca.	60	240	15.5	29 - 91
	2/9 treated by op. only, bilateral Ca.	22.2	192	13.9	0 - 50
25(b)	37.8/20.8 = 1.8, P = 0.07 Difference	37.8	432	20.8	not significant
	6/17 treated by op.+X-ray, bilateral Ca.	35.2	134	11.6	12 - 58
	7/27 treated by op.+X-ray, pelvic metastases	25.9	71.1	8.43	9 - 43
	9.3/14.32 = 0.65, P = 0.50 Difference	9.3	205.1	14.32	not significant
	2/9 treated by op. only, bilateral Ca.	22.2	192	13.9	0 - 50
	0/6 treated by op. only, pelvic metastases	0	216	14.7	0 - 29
	22.2/20.2 = 1.1, P = 0.26 Difference	22.2	408	20.2	not significant
	7/27 treated by op.+ X-ray, pelvic metastases	25.9	71.1	8.43	9 - 43
	15/23 treated by op.+ X-ray, unilateral Ca.	65.2	98.6	9.93	45 - 85
	39.3/13.03 = 3, P = 0.003 Difference	39.3	169.7	13.03	significant
25(b)	0/6 treated by op. only, pelvic metastases	0	216	14.7	0 - 29
	6/10 treated by op. only, unilateral Ca.	60	240	15.5	29 - 91
	60/21.3 = 2.8, P = 0.005 Difference	60	456	21.3	significant.

TABLE 3.

Cure-rate and operability-rate in the six complete series of recorded cases.

Series No;	Cure rate.	Per-cent.	Operability rate.	Per-cent.	Cured/operable ratio percent.	S.D.
1	83/265	31.3	221/265	83.5	37.8	3.3
24	29/145	20	93/145	64	31.2	4.8
25	38/213	17.8	92/213	43.2	41.3	5.1
23	18/153	11.75	48/153	31.4	37.5	7.0
18	7/75	9.33	23/75	30.66	30.4	9.6
6	4/57	7	14/57	25	28.6	12.1
TOTAL:179/908		19.7	491/908	54	36.5	2.2

From the calculation shown in Appendix C, the correlation coefficient between the ratios of cured cases to operable in the six series is  $0.9946 \pm 0.4472$ . The quotient is 2.2, therefore the correlation can be regarded as significant. The regression coefficient is 38.1% cured of the operable, the constant term in the regression equation being -1.3 cured, which is almost zero.

TABLE 4.

Methods of treatment in the 19 reported series of treated cases, arranged in order of percentage results of treatment.

Series No:	Method of treatment	Results percentage	S. D. percentage.
7	operation+ X-ray + Radium	45.2	6.3
10	Operation + X-ray	40	5.02
17	Operation only(3 year results)	40	4.38
5	Operation + 200 KV X-ray	39.3	5.33
11	Operation + 500 KV X-ray	32	6.6
19	Operation + abdominal X-ray baths	30.4	4.11
16	Operation + X-ray	27.5	3.16
8	Operation + 1000 KV X-ray	24	8.54
9	Operation + 200 KV X-ray	23.3	7.7
3	Operation only	21.3	3.94
15	Operation + X-ray	20.6	4.9
20	Operation + X-ray	20	5.97
13	Operation + 400 KV X-ray	19.7	4.9
4	Operation + X-ray + Radium	18.1	3.75
21	Operation only	17.4	2.99
14	Operation + X-ray for some	16.6	2.97
22	Operation + 200 KV X-ray for some	15.2	3.06
2	Operation + X-ray for some	12.7	4.2
12	Operation + 200 KV X-ray	5	4.87

TABLE 5.

Results in early operable cases without metastases as reported in twelve series.

Series No:	Method of treatment	Percentage results	S. D. percent.
17	Operation, 3 year results	80	10.3
19	Operation + abdominal bath X-ray	79	9.35
3	Operation	75	9.68
5	Operation + X-ray 200 KV	71.5	9.85
4	Operation + X-ray + Radium 3 year results	68	9.33
7	Operation + X-ray + Radium	65.6	8.4
16	Operation + X-ray	64.8	5.67
24	Operation + X-ray	56.25	12.4
25	Operation + X-ray	52.5	7.9
1	Operation + X-ray in some	49.5	4.66
22	Operation + 200KV X-ray in some	45.5	7.51
23	Operation + X-ray	40	12.65

TABLE 6.

Results in carcinoma confined to one ovary and results in carcinoma confined to the two ovaries, as reported in five series.

Series No:	Method of treatment.	Percentage.		Cures.	
		Unilateral Carcinoma.	Bilateral Carcinoma.	Bilateral Carcinoma.	Bilateral Carcinoma.
2	Operation <u>±</u> X-ray	15		6	
7	Operation + X-ray + Radium	70		40	
16	Operation + X-ray	59		80	
17	Operation	64		58	
25	Operation + X-ray	65		35	
25	Operation	60		22	

The differences in the percentages have no statistical significance in any series.

APPENDIX C.

The correlation between cure-rate and operability-rate  
in six series.

Series Ref.No.	Cases cured x	Cases operable y	Product xy	x <sup>2</sup>	y <sup>2</sup>
1	83	221	18343	6889	48841
24	29	93	2697	841	8649
25	38	92	3496	1444	8464
23	18	48	864	324	2304
8	7	23	161	49	529
6	4	14	56	16	196
<b>TOTAL:</b>	<b>179</b>	<b>491</b>	<b>25617</b>	<b>9563</b>	<b>68983</b>
<b>Means <math>\bar{x}</math></b>	<b>29.83</b>	<b><math>\bar{y}</math> 81.83</b>	<b>4269.5</b>	<b>1593.8</b>	<b>11497.1</b>
<b>Subtractions</b>			$\overline{xy}$ 2441.0	$\frac{1}{\bar{x}}$ 889.8	$\frac{2}{\bar{y}}$ 6696.1
<b>Differences</b>			<b>Sxy</b> 1828.5	$S^2$ 704	$S^2$ 4801

Product  $s^2 s^2$  = 704 X 4801 = 3,379,904

Square root ss = 1838.4

Correlation Coefficient =  $Sxy/ss$  = 1828.5/1838.4 = 0.9946

**SD** of series of 6 =  $1/\sqrt{5}$  = 0.4472

Hence r/s = 0.9946/0.4472 = 2.2

## APPENDIX D.

### Tests of Significance.

A difference between percentages has been accepted as significant when this difference divided by the standard error of the differences exceeds 2. The probability is then less than one in twenty that the difference is due only to chance.

Criticism of a result as "not significant" does not imply that the clinician is wrong in his interpretation but should be taken as an indication of the need for further trial and experiment, in order to accumulate more data. From the scientific aspect, the results can only be used as a basis for deduction, when the probability is high that chance variation could not cause the differences. A probability of 5% that the result is fortuitous is worth accepting, as a fair risk, but anything more than this probability exposes the enquirer to great risk of error.

The statistical analysis has been based on elementary methods described by LEVY and PREIDEL (1944) and HILL (1948).

## BIBLIOGRAPHY

### (a) Statistical.

- HILL, A.B. Principles of Medical Statistics 4th Edn.  
1948 pp.252 London: The Lancet Ltd.
- LEVY, H. and PREIDEL, E.E. Elementary Statistics 1944 pp.184  
London: Thos. Nelson & Sons.
- STOCKS, P. General Register Office studies on medical  
and population subjects No.1:  
Regional and local differences in cancer  
deathrates. (Table 11, p.18), 1947 pp.46  
S.O.Code No.70-527-1. London: His  
Majesty's Stationery Office.  
General Register Office studies on medical  
and population subjects No.3: Cancer  
registration in England and Wales. An  
enquiry into treatment and its results.  
1950 pp.80. S.O.Code No.70-527-3.  
London: His Majesty's Stationery Office.
- THE REGISTRAR GENERAL'S Statistical review of England and  
Wales for the six years 1940-1945 Text,  
Vol.1, medical (p.161) 1949 pp.388  
S.O.Code No.70-141-3-45. London:  
His Majesty's Stationery Office.

## BIBLIOGRAPHY.

### (b) Medical.

- ALLAN, M.S. and HERTIG, A.T. 1949, Am. J. Obstet. Gynec. vol.58, 640-653. Carcinoma of the Ovary.
- BAYLY, M.A. and GREENE, R.R. 1949, Am. J. Obstet. Gynec. vol.57, 984-988. Ovarian tumours and uterine bleeding.
- BLOCK, E. 1947, Acta Radiologica vol.28, 49-68. Primary carcinoma of the Fallopian tube.
- CAMPBELL, J.V. and SINGMAN, D. 1947, Western J. surg. Obstet. and Gynec. vol.55, 263-272. Primary ovarian malignancy.
- CASHMAN, B.Z. and HELSEL, E.V. 1949, Am. J. Obstet. Gynec. vol.57, 492-500. The treatment of advanced carcinoma of the ovary.
- DIDDLE, A.W. 1949 Am. J. Obstet. Gynec. vol.58, 790-794. End results in the surgical treatment of ovarian cancer.
- ELLIS, F. 1943-44. Proc. roy. soc. med. vol 37, 727-730. Discussion on the radiotherapy of malignant disease of the ovary.
- FREED, J.H. and PENDERGRASS, E.P. 1948. Cancer Research vol.8, 361-370. The diagnosis and treatment of primary ovarian carcinoma with special reference to radiotherapy.
- GAGNER, S. and SJÖVALL, A. 1949 Acta Obstet, Gynec, Scand. vol.38, 110-121. Ovarian and parovarian tumours in children: a report on 43 cases. [In English].
- HELSEL, E.V. 1946, Am. J. Obstet. Gynec. vol.52, 435-439 A review of 100 cases of ovarian cancer.
- HEYMAN, J. 1930. Surg. Gynec. Obstet. vol.50, 173-8. Radiology as a complete or partial substitute for surgery in treatment of cancer of the female pelvic organs.

- HOLMES, G.W. and SCHULZ, M.D. 1946, Am. J. Roentg. vol.55, 533-554. Supervoltage radiation. A review of the cases treated during an eight year period (1937-44 inclusive).
- JONES, F.H. 1941. Am. J. Surg., vol.52, 246-259. Papillary cystadenocarcinoma of the ovary.
- KERR, H.D. and EINSTEIN, R.A.J. 1945. Am. J. Roentg. vol.53 376-384. Results of irradiation of ovarian tumours.
- KERR, H.D. and ELKINS, H.B. 1951. Am. J. Roentg. vol.66, 184-189. Carcinoma of the ovary.
- LEUCUTIA, T. 1947 Am. J. Roentg. vol.58, 347-355. Comparative value of deep and supervoltage Roentgen therapy.
- LYNCH, R.C. and DOCKERTY, M.B. 1945 Surg. Gynec. Obstet. vol.80, 60-65. The spread of uterine and ovarian carcinoma with special reference to the rôle of the Fallopian tube.
- MARCHETTI, A.A. 1941 J. Am. Med. Assn. vol.41, 2324-2331 Ovarian cancer. Clinicopathologic evaluation.
- MARKS, J.H. and WITTENBERG, M.H. 1948. Surg. Gynec. Obstet. vol.87, 541-545. Results of treatment of carcinoma of the ovary with data on the age incidence of this disease.
- MEIGS, J.V. 1940 Surg. Gynec. Obstet. vol.71, 44-53. Cancer of the ovary.
- MILLER, N.F. 1948 J. Am. Med. Assn. vol.136, 163-169. Cancer of the uterus, ovary and tube.
- MONTGOMERY, J.B. 1948 Am. J. Obstet. Gynec. vol.55, 201-217. Malignant tumors of the ovary.
- MUNNELL, E.W. and TAYLOR, H.C. 1949. Am. J. Obstet. Gynec. vol.58, 943-955. Ovarian carcinoma. A review of 200 primary and 51 secondary cases.
- NORRIS, C.C. and MURPHY, D.P. 1932. Am. J. Obstet. Gynec. vol.23, 833-837. Malignant ovarian neoplasms with a report of the end-results in a series of 93 cases.
- O'DONOGHUE, J.G. 1949 Aust.N.Z.J.Surg. vol.19, 93-96. Cancer of the ovary. Review of results on 100 cases.

- PATERSON, R.; TOD, M. and RUSSELL, M. 1950. The results of radium and XRay therapy in malignant disease, being the third statistical report from the radium institute, Manchester. Edinburgh.E. and S.Livingstone.
- PEMBERTON, F.A. 1940. Am. J. Obstet. Gynec. vol.40,751-763. Carcinoma of the ovary.
- SWINTON, N.W. and YANCEY, C.R. 1947. Cancer of the ovary. The Surgical Clinics of North America Lahey Clinic Number 681-690 Philadelphia, Pa., U.S.A. W.B.Saunders Co.
- TAYLOR, C.W. 1950. J. Obstet. Gynec. Brit. Emp. vol.57, 328-334. The pathology of malignant ovarian tumours.
- TAYLOR, H.C. and GREELEY, A.V. 1942. Surg. Gynec. Obstet. vol.74, 928-934. Factors influencing the end results of carcinoma of the ovary. Report of a series of 138 patients treated from 1910 to 1935.
- TOD, M.C. 1943-44. Proc. Roy. Soc. Med. vol.37, 722-727. Discussion on the radiotherapy of malignant disease of the ovary.
- 1951 J. Obstet. Gynec. Brit. Emp. vol.63 385-387. The place of XRay therapy in the treatment of malignant ovarian tumours.
- WALTER, R.I.; BACHMAN, A.L. and HARRIS, W. 1941. Am. J. Roentg. vol.45, 403-411. The treatment of carcinoma of the ovary.
- WETTERDAL, P. 1949 Acta. Obstet. Gynec. Scand. vol.28, 510-522. Some aspects of the diagnosis and treatment of carcinoma of the ovary.
- WILLIAMS, I.G. 1944 J. Obstet. Gynec. Brit. Emp. vol.51, 489-494. Carcinoma of the ovary.

Acknowledgement.

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I have to thank Dr.J.S.Fulton, C.B.E.,  
T.D., M.D., F.R.C.P.E., F.F.R., D.R.,  
Director of Radiotherapeutic Services,  
Liverpool Region, for his kindness in  
allowing me to use the material from the  
Clinical Registry.