

## THE URETER AND HYSTERECTOMY

Including the Effects of Certain Gynaecological Conditions on the Urinary Tract

BY

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"I do not yet see any mode of certainly providing against the mischance of tying or dividing one or both ureters. I fear that with all possible care it is an accident which may occasionally prove unavoidable."

T. Spencer Wells, 1882.

GYNAECOLOGICAL operations are a common source of ureteric injuries. In 48 cases of injured ureter described by Badenoch (1959), 39 followed a gynaecological operation. It is well established that radical hysterectomy performed for carcinoma of the cervix is associated with a special risk of ureteric fistula. The incidence of such complications has been described as 9 per cent by Liu and Meigs (1955). In a series of 236 cases of operative injuries to the ureter collected by Feiner (1938) 23 per cent followed radical abdominal hysterectomy. The main purpose of this investigation, however, was to observe the effect on the ureter of simple, as opposed to radical hysterectomy, performed in the main part for benign conditions.

Ureteral injuries occur after almost any type of gynaecological operation. The incidence of such injuries has been described as being 1-3 per cent by Feiner (1938) of all operations on the female genital organs. It is worth noting that in Feiner's series referred to above 38 per cent of the injuries followed total and sub-total hysterectomy for benign conditions. However, the incidence of ureteric injuries in any series of hysterectomies must depend on a number of factors. The most important of these are probably:

- (1) The skill of the operator.
- (2) The type of case operated upon.
- (3) The extent of the operation.

(4) The technique of the operation.

(5) The skill of the anaesthetist.

The possible injurious effects of simple hysterectomy on the ureter, apart from those observed at operation, can be described as follows:

(1) There may be gross damage to the ureter revealed in the immediate post-operative period by the development of anuria, severe pain or a urinary fistula. In the early days of hysterectomy there was a high incidence of such complications. In 1882 Spencer Wells stated that out of 94 published cases of hysterectomy one ureter had been divided in 6 cases, and both ureters in 2 other cases. In 1898 Sir Henry Morris said that at that time of any 100 hysterectomies one or both ureters were tied or cut across in at least 3 cases. Improvements in the technique of the operation and in addition the recent great advances in anaesthesia have probably reduced the incidence of obvious ureteric injuries considerably in the past 25 years, but such injuries still play a part in the morbidity and mortality of simple hysterectomy.

(2) There may be concealed damage to the ureter. For many years it has been suggested that not all ureteric injuries reveal themselves in a dramatic fashion in the post-operative period, and that some went undetected. In 1935 Webb-Johnson gave his opinion that unrecognized injuries of the ureter during hysterectomy occurred more often than was commonly believed. Feiner (1938) states "It is quite likely that a certain number of unilateral ligations occur which are not recognized and which do not provoke immediate symptoms, with ultimate auto-

nephrectomy on the corresponding side". Again, Wharton (1947) says: "Ureteral injuries occur more frequently than the operative statistics indicate. Some ureters that are ligated cause no symptoms and no fistulae—the kidney merely ceases functioning."

(3) Disturbance of ureteric function may occur as a result of anatomical displacement, of interference with the blood supply or innervation, or of compression of the ureter by a pelvic haematoma. This disturbance may be temporary only, but it is possible that severe kinking of the ureter or fibrosis around the ureter might give rise to permanent and progressive deterioration in ureteric function. Millin (1949) described 3 cases of death from anuria proved at autopsy to have been due to extrinsic pressure on both ureters by a retroperitoneal haematoma following hysterectomy and described a fourth successfully treated by evacuation of the haematoma.

It was considered that a close clinical and radiological study, by means of intravenous pyelography, might indicate the frequency and nature of such injurious effects following the operation of simple hysterectomy.

Before such a study could be undertaken, however, it was necessary to examine the effects of certain gynaecological conditions on the urinary tract. Disturbed ureteric function discovered in the post-operative period might merely be the aftermath of pre-operative ureteric dilatation, produced by the gynaecological lesion rather than the result of the hysterectomy. Although there have been many isolated reports of gynaecological conditions causing urinary tract dilatation there have been remarkably few comprehensive investigations into this subject. Millin (1949) stated: "I have been unable to find any exhaustive statistics on the incidence of upper urinary tract dilatation in this connection" (pelvic inflammation and benign tumours) "but a perusal of several small series would appear to show the following approximate figures:

	Per cent
Pelvic inflammatory conditions ..	60
Fibroids large .. .. .	66
"    small .. .. .	30
Ovarian cysts .. .. .	40"

METHOD OF INVESTIGATION

(1) One hundred and ten patients who were admitted to the gynaecological wards for hysterectomy were examined by intravenous pyelography before operation, i.e., the "pre-operative investigation". Cases of invasive carcinoma of the cervix were excluded, but other malignant conditions, for example, carcinoma of the body of the uterus and carcinoma of the ovary, were included.

(2) The same patients had a second intravenous pyelogram performed in the third post-operative week, i.e., "the post-operative investigation".

(3) A few selected cases were given a further radiological examination 12 to 18 months after the operation, i.e., "the follow-up investigation".

(4) A simultaneous examination of the case records and X-rays of each patient was made to compare the clinical, operative and radiological findings.

PART I

PRE-OPERATIVE INVESTIGATION

The main purpose of this part of the investigation was to try to determine what gynaecological conditions, other than carcinoma of the cervix, cause back pressure changes in the upper urinary tract, and what are the effects of operating on patients who show such changes. In addition, the opportunity was taken of studying the lower urinary tract before and after operation, and the incidence of congenital abnormalities of the urinary system was noted.

A total of 110 patients had an intravenous pyelogram performed before operation. Of these, 16 or 14.5 per cent showed dilatation of the upper urinary tract. In 1 case the degree of dilatation was gross, affecting both kidneys and ureters. In the remaining 15 cases there was slight or moderate dilatation of the renal pelvis or ureter. In 9 cases the right side only was abnormal and on 6 occasions the dilatation was bilateral.

The pathological lesions present in those patients showing pre-operative dilatation are listed in Table I.

TABLE I

Large fibroids .. .. .	7
Large ovarian cysts (benign) .. .. .	3
Large fibroid and large cyst .. .. .	1
Large fibroid and endometriosis .. .. .	1
Malignant ovarian cysts .. .. .	2
Small fibroids and endometriosis .. .. .	1
Small fibroids .. .. .	1
	—
	16

## SIZE OF TUMOUR

The findings with regard to pre-operative dilatation were then considered in relation to the size of the tumour present. Large tumours were defined as those which filled the pelvis and/or were palpable above the pelvic brim. There were 41 such large tumours, and these were made up of:

Fibroids .. .. .	32
Ovarian cysts (including two malignant) .. .. .	9

The number of large tumours associated with pre-operative dilatation was 14 or 34·1 per cent.

There were 35 cases in which the tumour was small in size, small tumours being defined as intra-pelvic tumours which did not fill the pelvis. Cases in which the uterus was of normal size were not included. The group of small tumours was made up as follows:

Fibroids .. .. .	26
Ovarian cysts .. .. .	3
Fibroids and ovarian cyst .. .. .	1
Adenomyoma .. .. .	1
Chronic subinvolution .. .. .	2
Fimbrial cyst .. .. .	1
Fimbrial cyst and ovarian cyst .. .. .	1

The number of small tumours associated with pre-operative dilatation was 2 or 5·7 per cent.

## PATHOLOGY

The incidence of pre-operative dilatation was next considered in relation to the individual pathological lesions present.

*Fibroids*

The total number of cases with fibroids was 61, and of these 11 or 18 per cent showed pre-operative dilatation. Thirty-two patients had by

definition "large" fibroids, and the number of these associated with pre-operative dilatation was 9 or 28·1 per cent.

In 29 cases the fibroids were "small" in size and only 2 or 6·9 per cent showed pre-operative dilatation. One of these cases had endometriosis as well as small fibroids, and the other patient was later diagnosed as having congenital hydro-ureters.

*Ovarian Tumours*

Fourteen patients had ovarian tumours and 6 of these or 43 per cent showed dilatation of the upper urinary tract at the pre-operative investigation. "Large" ovarian tumours numbered 9, including 2 malignant cases. The number of these showing pre-operative dilatation was 6 or 66·6 per cent.

There were 5 small ovarian tumours but none of these showed urinary tract dilatation pre-operatively.

*Endometriosis*

The number of cases with endometriosis was 16, but many of these had other lesions as well. An abnormal pre-operative film was obtained in 2 or 12·5 per cent. In addition one patient had "large" fibroids, and one had "small" fibroids.

The pathological lesions present in the remaining cases were as follows:

Carcinoma of the body .. .. .	9
Adenomyoma .. .. .	2
Functional uterine haemorrhage .. .. .	19
Chronic salpingitis .. .. .	3
Chronic parametritis .. .. .	1
Chronic subinvolution .. .. .	2
Prolapse .. .. .	6
Fixed retroversion .. .. .	3
Fimbrial cysts .. .. .	2
Carcinoma of the cervix Stage 0 .. .. .	1

In none of these cases was there any pre-operative dilatation of the upper urinary tract.

## THE EFFECT OF OPERATION ON PATIENTS SHOWING PRE-OPERATIVE DILATATION

The operations performed on the 16 patients with pre-operative dilatation of the upper urinary tract are listed in Table II.

TABLE II

Total hysterectomy and bilateral salpingo-oöphorectomy .. .. .	8
Total hysterectomy and unilateral salpingo-oöphorectomy .. .. .	2
Total hysterectomy .. .. .	2
Sub-total hysterectomy .. .. .	1
Sub-total hysterectomy and unilateral salpingo-oöphorectomy .. .. .	1
Bilateral ovariotomy .. .. .	1
Left salpingo-oöphorectomy and right ovarian cystectomy .. .. .	1
	—
	16

RESULTS

A post-operative intravenous pyelogram performed on 14 of these 16 patients who showed pre-operative dilatation revealed the following results: Ten patients were found to have a normal pyelogram. In 2 patients the condition was improved, and both were found to be normal when a follow-up intravenous pyelogram was performed 12 to 18 months later. In 2 patients there was no change post-operatively. On follow-up one was found to be normal but the other still showed the same degree of dilatation. This patient was later diagnosed as having a congenital hydro-ureter.

Two patients in error did not have a pyelogram performed in the post-operative period. On follow-up one was found to be normal radiologically but no examination was possible in the other as the patient had died of an intercurrent disease.

These results are summarized in Table III.

TABLE III

Normal .. .. .	10
Improved .. .. .	2 (on follow-up both normal)
No change .. .. .	2 (on follow-up 1 normal, 1 I.S.Q. (congenital hydro-ureter))
No post-operative I.V.P. .. .. .	2 (on follow-up 1 normal, 1 died intercurrent disease)
	—
	16

LOWER URINARY TRACT

Displacement of the pelvic portion of the ureter was a common finding in the pre-opera-

tive investigation. In fact 22 cases out of the 110 examined showed marked displacement of the lower ureter, almost always in association with a large pelvic tumour. In the majority of cases this displacement was in a lateral direction bringing the ureter closer to the side wall of the pelvis than usual. In 6 of these cases there was in addition dilatation of the upper urinary tract. In the great majority, 18 of these 22 cases, the ureter was found to occupy a normal position at the post-operative examination.

Distortion of the bladder was an even more frequent finding occurring in 56 cases, mostly due to the presence of a pelvic tumour. In all except 9 cases the distortion corresponded closely to the findings at operation. In some cases a soft tissue mass indented the bladder or flattened it generally. In other cases there was displacement to one side by a tumour or pulling up of the bladder by an area of endometriosis. In all except 4 cases the bladder picture returned to normal following removal of the tumour. In 2 patients there was marked descent of the bladder neck as a result of prolapse. In 2 other patients there was a distorted bladder outline due to previous operations. One patient had had a ventro-suspension, and the pre-operative picture showed marked indentation of the fundus of the bladder. The other patient had elevation of the bladder which could be attributed to a previous salpingo-oöphorectomy. In the latter case the distortion persisted in the post-operative picture.

CONGENITAL ABNORMALITIES

Congenital abnormalities were discovered in 7 of the 110 patients examined, an incidence of 6.4 per cent. These are listed in Table IV.

TABLE IV

Double left kidney and double left ureter .. .. .	2
Double left kidney and double left ureter as far as the pelvic brim .. .. .	2
Bilateral double ureter as far as the pelvic brim .. .. .	1
Abnormally low right kidney .. .. .	1
Congenital hydro-ureter .. .. .	1
	—
	7

TABLE V

	Kretschmer and Kanter	Everett and Sturgess	Present Series
Number of patients investigated .. .. .	51	100	110
Percentage incidence of pre-operative dilatation:			
All cases .. .. .	64.7	50	14.5
Large fibroids .. .. .	62.5	00	28.1
Small fibroids .. .. .	44.5	30	6.9
Ovarian tumours .. .. .	81.9	40	43
Pelvic inflammatory conditions .. .. .	nil	44-58	nil

### DISCUSSION

The findings in the present series and those of the two previous investigations described by Kretschmer and Kanter (1937) and Everett and Sturgess (1940) are compared in Table V.

It is apparent from Table V that the overall incidence of pre-operative dilatation of the upper urinary tract varies considerably in these three series. It is likely the discrepancy is partly accounted for by a difference in the type of patient investigated. An example of this would be the decreased incidence of cases of chronic pelvic inflammatory disease encountered today as compared with 25 years ago.

Pregnancy is probably the best known example of a benign gynaecological condition causing back pressure changes in the urinary tract. The marked dilatation and kinking of the ureters above the pelvic brim are generally believed to be due to the combination of pressure exerted by the growing uterus and hormonal changes. In this series the degree of dilatation, apart from the one case of congenital hydro-ureter, was considerably less than that seen in pregnancy, but it was of interest to observe that, as in pregnancy, the right ureter appeared to be more vulnerable than the left.

As might be expected the highest incidence of upper urinary tract dilatation was found in patients who had large ovarian cysts. In this respect ovarian cysts resemble pregnancy, being rapidly growing tumours of soft consistency, which mould themselves to the shape of the pelvis. It is of interest to note that the dilated urinary tracts associated with the 2 malignant ovarian cysts returned to normal after operation.

This suggests that pressure rather than malignant invasion was the cause of the abnormal pre-operative intravenous pyelograms.

Fibroids being of firmer consistency and growing at a slower rate than ovarian tumours do not appear to cause upper urinary tract dilatation quite so frequently. In general, however, it would appear that the size of the tumour present is the most important factor in producing back pressure changes in the ureter, for the incidence of such changes in association with large tumours was 34.1 per cent as compared with 5.7 per cent amongst patients with small intra-pelvic tumours.

In the present investigation 62.5 per cent of patients showing upper urinary tract dilatation returned to normal within 3 weeks of operation. In addition a further 25 per cent returned to normal within 12 to 18 months. One of the remaining patients had a congenital hydro-ureter and therefore removal of small fibroids could hardly be expected to have any effect.

The frequency with which the pelvic portion of the ureter was in an abnormal position at the time of operation is significant especially as, in addition, 2 patients had double ureters on the left side of their pelvis.

It has been said of the urinary tract that no other visceral system is so frequently malformed, and this statement is borne out by the high incidence, 6.4 per cent in this series. Smith and Orkin (1945), in a clinical and statistical study of 471 congenital anomalies of the kidney and ureter, found an incidence of duplication of the renal pelvis and ureter to be 1 in 190. Five such cases were discovered in the 110 patients examined in this series.

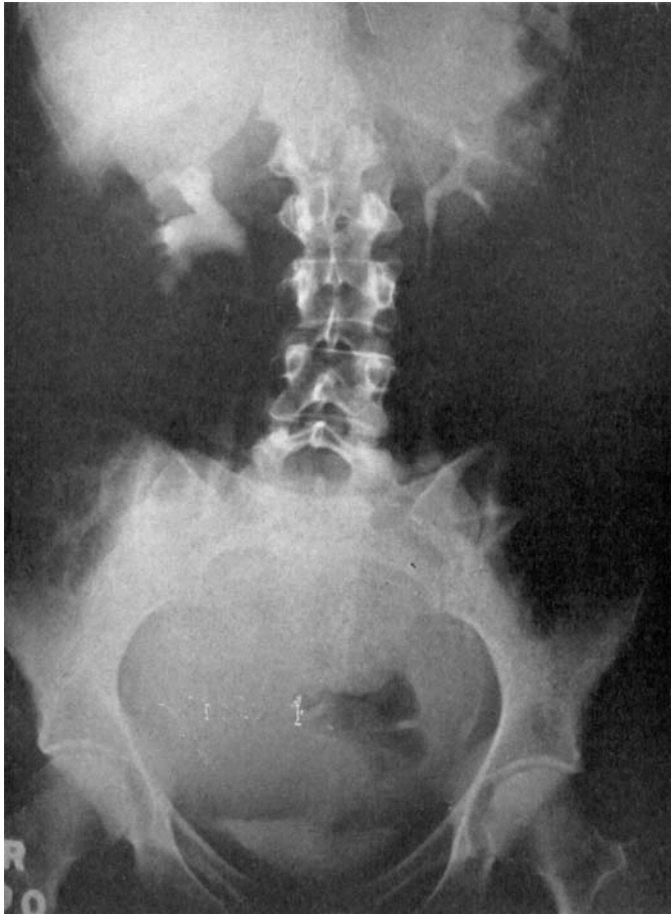


FIG. 1

Case No. 94. Pre-operative X-ray showing moderate right-sided hydronephrosis due to large fibroids.

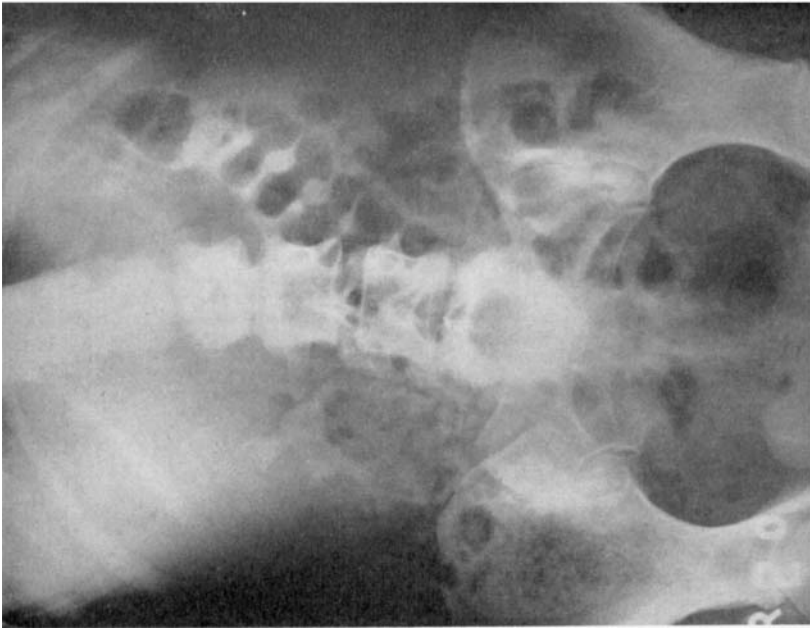


FIG. 2

Case No. 94. Post-operative X-ray showing an improvement in the right upper urinary tract.

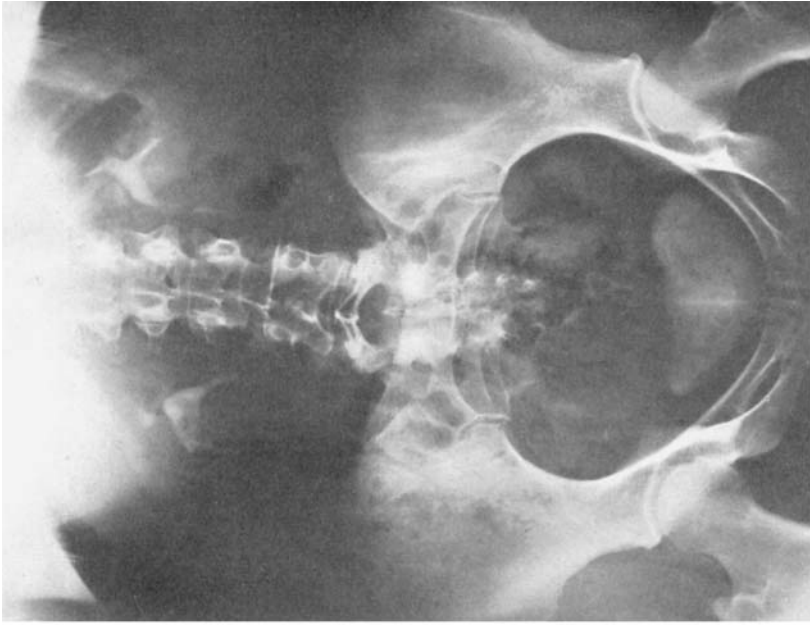


FIG. 3

Case No. 94. Follow-up X-ray showing a return to normal.

Bladder distortion was a common finding and it is of interest to note that in the great majority of cases the deformity as seen in the X-ray picture corresponded very closely with the findings at operation.

PART II

POST-OPERATIVE INVESTIGATION

The aim of this part of the investigation was to try and determine the effect of simple hysterectomy on the ureter that was known to be normal before operation. In addition an attempt was made to discover whether marked kinking of the lower end of the ureter post-operatively resulted in any permanent impairment of renal function.

MATERIAL

Of the 110 patients who had pre-operative investigation 10 did not have an abdominal hysterectomy performed. This leaves 100 patients who had an abdominal hysterectomy. Thirteen patients had to be excluded from the post-operative investigation because the intravenous pyelogram performed pre-operatively showed back pressure changes in the upper urinary tract. In addition, 7 cases in error did not have a post-operative intravenous pyelogram. This leaves 80 patients with a normal pre-operative intravenous pyelogram who were available for study with post-operative films.

POST-OPERATIVE DILATATION

The operations performed in the 80 cases of abdominal hysterectomy are listed in Table VI.

TABLE VI

Total hysterectomy .. .. .	20
Total hysterectomy and bilateral salpingo-oöphorectomy .. .. .	43
Total hysterectomy and left salpingo-oöphorectomy .. .. .	3
Total hysterectomy and right salpingo-oöphorectomy .. .. .	1
Sub-total hysterectomy .. .. .	2
Sub-total hysterectomy and bilateral salpingo-oöphorectomy .. .. .	10
Sub-total hysterectomy and left salpingo-oöphorectomy .. .. .	1
	—
	80

Of these 80 patients the number who showed post-operative dilatation of the upper urinary tract was 3. The degree of dilatation in all cases was slight and on follow-up 12 to 18 months later all were found to be normal. No abnormality was discovered in the upper urinary tracts of the remaining 77 patients and there was no case of gross ureteric injury either of the revealed or concealed type.

The case histories of the 3 cases showing post-operative dilatation were as follows:

No. 74

Age. 60.

Complaint. Post-menopausal bleeding.

Diagnosis. Multiple uterine fibroids.

Operation. Total hysterectomy and bilateral salpingo-oöphorectomy was performed for multiple small fibroids and bilateral small serous cystadenomata. One fibroid was pedunculated and one fibroid was degenerating in a submucous position. No difficulties were encountered during the operation. The recovery was uneventful.

No. 91

Age. 51.

Complaint. Backache and difficulty in defaecation.

Diagnosis. Fixed retroversion.

Operation. Total hysterectomy and bilateral salpingo-oöphorectomy for a bulky fixed retroverted uterus due to endometriosis. Difficulty was encountered in stripping the bladder off the cervix. No other operative difficulties were met. The recovery was uneventful.

No. 64

Age. 53, nulliparous.

Complaint. Post-menopausal bleeding.

Diagnosis. Multiple small uterine fibroids.

Operation. Sub-total hysterectomy and bilateral salpingo-oöphorectomy for multiple small fibroids. Difficulty was encountered in stripping the bladder off the cervix. No other difficulty was met during the operation. The uterus was opened during the operation and the endometrium was found to be normal. The recovery was uneventful, apart from a urinary infection due to *Escherichia coli*.

POST-OPERATIVE KINKING OF THE LOWER URETER

In 8 patients marked kinking of the pelvic portion of one or both ureters was discovered during the post-operative investigation. All these 8 patients had had a bilateral salpingo-oöphorectomy performed in addition to the



hysterectomy. Three of the 8 patients showed in addition slight back pressure changes in the upper urinary tract. A follow-up investigation was performed in 4 cases including the 3 who showed back pressure changes, and in no case was there any evidence of upper urinary tract dilatation. The lower ends of the ureters were not visualized in any of the follow-up examinations.

#### THE BLADDER, POST-OPERATIVELY

In all except 4 cases the bladder outline was normal at the post-operative investigation. In these 4 patients there was indentation of the bladder or "veiling off" by an extrinsic "tumour". The causes of these abnormal findings were 3 large pelvic haematomas and 1 pelvic abscess. In no case was there any associated abnormality of the upper urinary tract.

#### DISCUSSION

Judged by the results obtained in this series simple hysterectomy would appear to have remarkably few adverse effects on the urinary tract. These findings are in marked contrast to the grossly disturbed state of the urinary system after radical hysterectomy as recently described by Hanafee *et al.* (1958). Bilateral hydro-nephrosis and an atonic bladder are commonly found in the early stage of recovery from the radical operation and are probably the result of surgical trauma and interference with the blood supply. Many of these injuries apparently recover after a period of weeks, but in some necrosis occurs with resultant fistula formation.

Following simple hysterectomy upper urinary tract dilatation is comparatively rarely found. In the present series of 100 hysterectomies such a change was discovered in only 7 patients—in 3 cases it was due to the preceding gynaecological lesion, 1 case was congenital in origin and in only 3 patients was the dilatation the direct result of the operation. These findings suggest that dilatation of the upper urinary tract discovered in the immediate post-operative period following simple hysterectomy is just as likely to be the aftermath of a pre-operative pressure effect as to be the result of the operation itself. Without a pre-operative intravenous pyelogram

it would be difficult to arrive at a correct interpretation of such a finding.

In the 3 patients in whom the operation did produce disturbances of the upper urinary tract in this series, the degree of dilatation was slight and of a temporary nature only. There were two observations which might indicate the reasons for the findings in these particular patients. In 2 cases the operation notes described difficulty in displacing the bladder downwards off the cervix, and it is possible that the additional trauma produced in this stage of the operation might be a causative factor in the subsequent ureteric dilatation. Secondly, marked kinking of the lower end of the ureters was observed in the post-operative pictures of these 3 patients. All had had bilateral salpingo-oophorectomy performed as well as the hysterectomy. The avoidance of overtight continuous suturing to repair the pelvic peritoneum or possibly the substitution of interrupted "tacks" as advised by Howkins (1954) might help to avoid the disturbance of ureteric function. Five other patients also showed marked kinking of the pelvic ureter following operation, which included removal of the tubes and ovaries in all cases, but they were not associated with any dilatation of the upper urinary tract.

In general simple hysterectomy would appear to be beneficial to the urinary tract far more frequently than it is injurious. Back pressure changes in the upper urinary tract produced by gynaecological lesions are relieved completely following the operation usually in the space of a few weeks. Ureters that have been displaced in their pelvic course are in the majority of cases returned to a normal position. The effects of operation on the bladder are most marked. Distortion and displacement disappear following the removal of the offending tumour in the great majority of cases. The main exceptions to a normal bladder picture post-operatively would appear to be those cases in which the distortion is due to prolapse or a previous pelvic operation or the result of a large pelvic haematoma or abscess.

It has been suggested that post-operative urinary tract dilatation is an important cause of urinary infection following hysterectomy. It is of interest to note that only 2 out of the 7 patients

who had some degree of ureteric dilatation in the post-operative period did in fact develop such an infection. This finding suggests that there are other more important factors in the aetiology of urinary infection following hysterectomy.

#### SUMMARY

(1) An investigation into the state of the urinary tract in 100 patients before and after the operation of simple hysterectomy is described, with particular reference to the ureter.

(2) In regard to the ureter 14 patients were made better by the operation, upper urinary tract dilatation being completely relieved. In 3 patients hysterectomy produced a temporary dilatation only, which disappeared within 18 months. No case of gross injury to the ureter was observed.

(3) As far as the urinary tract is concerned, the effects of hysterectomy would appear to be beneficial far more frequently than they are injurious.

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