DOSE VARIATIONS INDUCED BY THE BLADDER DURING INTERAUTERINE RADIUM

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INTRODUCTION

The radiation dose received by the lymph nodes on the lateral pelvic wall from intrauterine radium varies over a wide range. Sandler (1942) and Kottmeier (1952) found the following doses at the soft tissues on the pelvic wall from different techniques :—

Paris technique	from 1720 r to 2810 r.
Marie Curie Hospital	from 1680 r to 2170 r.
Manchester Holt Inst.	from 2240 r to 6900 r.
Stockholm technique	from 610 r to 2240 r.

The variation in the dose to the rectum urinary bladder and laternal pelvic lymph nodes depends on 1. the degree of retroversion of the uterus and its anteflexion, and 2. upon the size of the vaginal applicator.

The position of the uterus varies considerably in relation to the bony pelvis depending mainly on the condition of the urinary bladder. When the bladder is empty, it is placed entirely within the bony pelvis like an empty corrugated ballon nFig. 1. As it fills its superior and posterior surfaces gradually rise upwards and posteriorly towards the abdomen. This change in size and position of the urinary bladder was studied to see to what extent it affects the uterus. Later the change in position of the uterus carrying radium and how it affects the dose received by the lateral pelvic lymph nodes was measured in a phantom.

MATERIAL AND METHOD

The variation in size and position of the bladder was studied by distending the Bilharzially - calcified bladder of a female patient by increasing amounts

of saline and radiographing it, fig. 2 & 3. The effect of the bladder when empty and full on the position of ovaries, tubes, uterus, broad ligaments and Douglas pouch in relation to the bony pelvis was also radiographed in case of hysterosalpingography, fig. 4 & 5. It is quite evident that when the bladder is empty the uterus isdirected forwards and at the same time is bent on itself at the junction of the body and cervix so that the body lies on top of the bladder. As the bladder fills the uterus gradually becomes more and more vertical in direction. With a fully distended bladder the fundus becomes directed backwards towards the sacrum. When the bladder is empty, the surfaces of the broad ligamne taredirected upwards and downwards and it has a free anterior and an attached posterior border. As the bladder fills, the plane of the broad ligament alters and its free border becomes superior in position. With it the Douglas pouch rises upwards and its relationship to the pelvic wall changes.

PHYSICAL MEASURMENTS

An anatomical phantom described in a previous publication Khalid 1966 was used to carry out the measurments at the sites of the pelvic lymph nodes 1. obturator lymph node 2. iliac lymph node and 3. hypogastric lymph node. fig. 6,7,8. These measurments were done for the three conditions of the bladder 1. when empty 2. when half full and 3. completely full. Sievert's condenser chambers each measuring 9/15 mm were used. Manchester ovoids were used.

RESULT

As seen from the accompanying figure and as tabulated, the dose received at the different sites of lymph nodes varies with the state of filling of the bladder due to variation in the position of the radium in relation to the lymph nodes, fig. 10 & 11.

(a) *Uterus Anteverted Anteflexed*

Condition of bladder	Obturator l.n.	Iliac l.n.	Hypogastric l.n.
Bladder empty	1560 r	1100 r	850 r
Bladder Half full	1130 r	1100 r	1530 r
Bladder full	890 r	1100 r	2170 r

(b) *Uterus Retroverted*

Bladder empty	900 r	1540 r	1280 r
Bladder half full	690 r	1450 r	2640 r
Bladder full	520 r	1300 r	3370 r

DISCUSSION

As the aim of radiotherapy is to deliver a predetrmined dose to certain points inside the pelvis, this continuous change of position of the intrauterine radium in relation to the pelvic lymph nodes will not allow this point to be fulfilled. As demonstrated the continuous change of position of the uterus under the effect of the bladder will cause the pelvic lymph nodes to receive varying doses of radiation.

The lymphatic drainage of the cervix uteri goes to the 1. obturator gland, 2. Iliac gland, " ganglion principal " and 3. hypogastric glands. On a radiograph, the hypogastric glands lie just below the lower end of the sacroiliac joint, and the obturator gland one-third of the distance between Shenton's line and a line joining the upper limits of the heads of the femora. The ganglion principal is between these two, fig. 12.

With regard to the dose received by the various lymph glands, Ellis, using the Stockholm technique giv es he followg data :

lateral cervical gland	3000 r- 15000 r
external iliac gland	1000 r
hypogastric gland	1500 r
common iliac gland	500 r
obturator gland	2000 r - 4000 r
lateral sacral gland	3000 r - 4000 r

It is noticed that there is marked variation of dose, which is nearly doubling in certain areas. This can be easily explained by the variation of the position of the uterus carrying the radium in relation to the lymph glands.

Taylor (1940) states " that the dose on the pelvic wall varies from 900 r to 2000 r when the uterinetube is central. The dose received by the hypogastric glands is largely dependent on the position and length of the uterine tube ". This becomes evidentif it is noted that there is steep intensity gradient round the radium applicators sot hat for two pointsreceiving 6000 r and 4000 r respectively would only be sperated by less than 5 mm fig. 13. This variatiom in dose is further complicated by the displacement of the uterus to the right or to the left. So both sides of the pelvis do not receive equal amounts of radiation. "

Kottmeier (1951) found that the doses measured at different points along the course of the obturator nerve were practically the same, though the doses measured on the right and left respectively varied according to the degree of displacement of the uterus. At the junction of the internal and external iliac attery the average dose was only about 800 r. Within the area of the iliac and

hypogastric nodes, 60 to 65 per cent of the dose originated from the intra uterine radium. At the level of the lower hypogastric nodes and the obturator node (point B), intrauterine and vaginal radium governed equal percentages.

Comparing the present results with the findings of others, it becomes evident that the state of filling of the bladder and the position of the uterus have a definite effect on the dose received by the lateral pelvic lymph nodes. Further studies will be given in a future communication.

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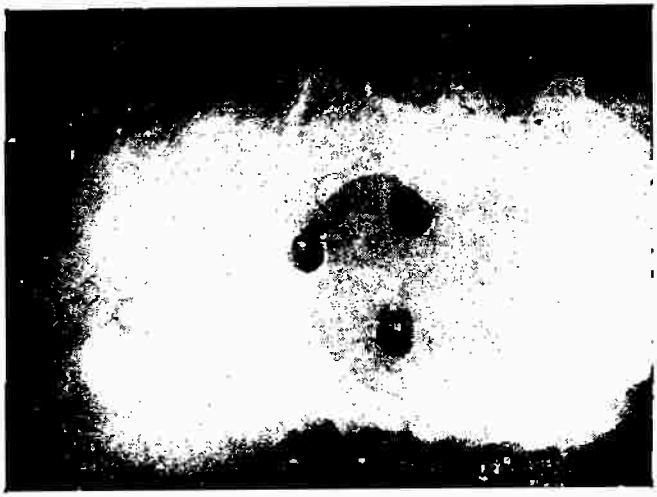


Fig. 9. Axial view of Phantom

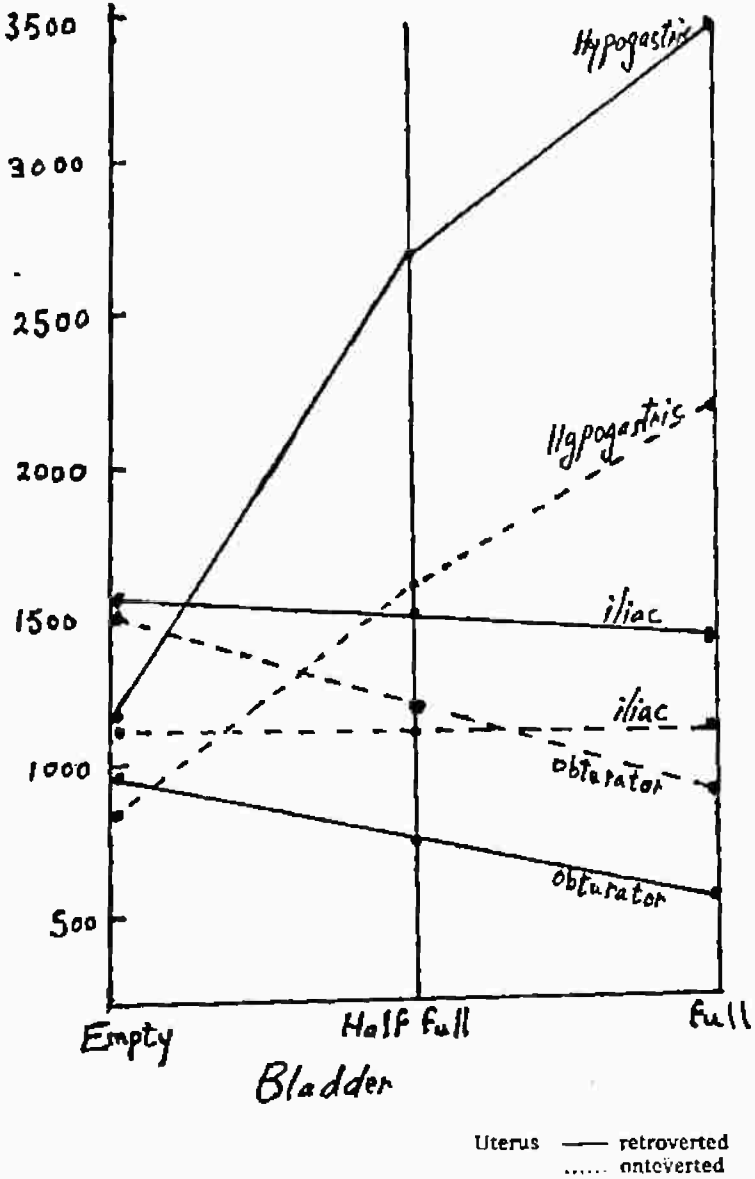
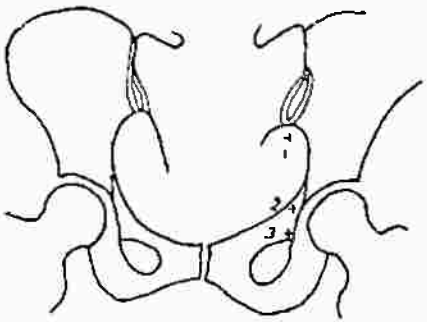
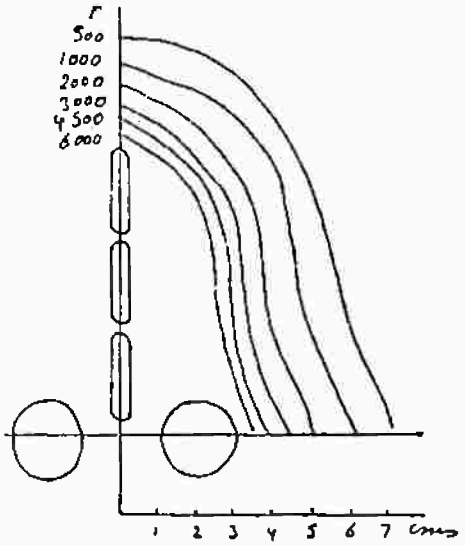

3500
3000
2500
2000
1500
1000
500
Hypogastric
Hypogastric
iliac
iliac
obturator
obturator
Empty
Half Full
Full
Bladder
Uterus —— retroverted
..... anteverted

Fig 10.

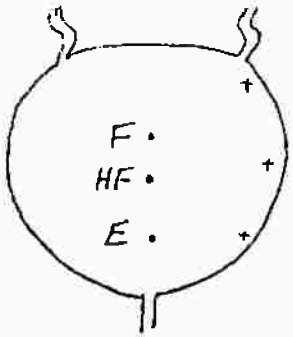


1. Hypogastric
2. iliac
3. obturator

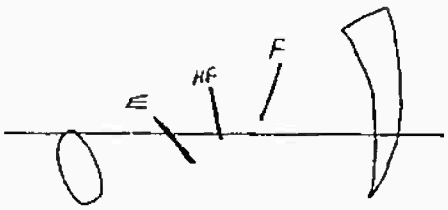
Pelvic Lymph Nodes Radiograph



Isodose Curves for Radium in Uterine tube and ovoids



Position of bladder in relation to lymph nodes



Change of position of uterus by state of filling of bladder

Fig. 11.