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Radiotherapy of Uterine Cervical Cancer Using Fletcher-Suit-Delclos Cesium Applicator

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From Nov. 1983 through Feb. 1986, 35 patients of uterine cervical cancer were treated by external radiation therapy and intracavitary radiation therapy using Fletcher-Suit-Delclos applicator. Age of the patients ranged from 32 to 70 years (median age: 53 years). All patients had follow up from 9 to 34 months and median follow up of 20 months. 4 patients were in stage I, 25 were in stage II, 5 were in stage III and I was in stage IV.

Overall regression rate was 80% and uncorrected actuarial 2 year survival rate was 88%. The incindence of rectal complications were analyzed. There was no rectal complication in the patients who received less than 7000 rad maximal rectal dose, but 2 out of 17 patients who received more than 7000 rad developed moderate degree (grade 2) of rectal complication.

In viewing of our results, Fletcher-Suit-Delclos applicator (3M) seemed to be an appropriate instrument for intracavitary radiation therapy in the patients of uterine cervical cancer.

Key Words: Uterine cervical cancer, Fletcher-Suit-Delclos applicator, Rectal complications.

INTRODUCTION

The role of radiation therapy in uterine cervical cancer has long been significant. The high curability of uterine cervical cancer was already reported in 1900s[1]. In early years, intracavitary irradiation alone was practiced. In 1920s, high energy X-ray machine was introduced and combination of external and intracavitary radiation therapy showed marked improvement in the management of uterine cervical cancer[2]. Further with the development of radiobiology, radiation physics, the technics of radiation therapy and surgical management, the cure rate of uterine cervical cancer was raised upto 60%[15].

The role of intracavitary radiation therapy is important in the treatment of uterine cervical cancer by radiation. This method of treatment can deliver high dose to uterine cervix but much less dose to adjacent normal organs such as bladder, rectum and small bowel.

Intracavitary radiation therapy is performed by inserting tandem and colpostats into uterine cavity and bilateral vaginal fornices respectively and inserting the radioactive souces into the applicators. The dwelling time of radioactive sources is determined by computerized measurement on each reference points.

Recently Cesium-137 has been widely used instead of Radium-226 becuse it is convenient to shield radiation exposure to personnels. The preloading system had changed into the afterloading system and furthermore into the remote afteroading system.

In practice, many types of applicators are used in intracavitary radiation therapy. However the most commonly used one is Fletcher-Suit applicator. In the present study, Fletcher-Suit-Delclos applicator (3M) was used. Compared with standard applicator, small sized colpostats of Fletcher-Suit-Delclos applicator can be used in the narrow vagina, but due to small size of the ovoids, the increase of radiation dose to bladder and rectum may occur. This study was done to analyze the results of radiation therapy combined with external radiation therapy in 35 patients of uterine cervical cancer.

MATERIALS AND METHODS

MATERIALS: Between Nov. 1983 and Feb. 1986, 68 patients of uterine cerical cancer were treated at the department of therapeutic radiology, Inje

Medical College, Seoul Paik Hospital. among these 68 patients, 35 patients were treated by intracavitary radiation therapy combined with external radiation therapy. We analyzed these 35 patients respectively. These 35 patients were treated with curative aim.

Fletcher-Suit-Delclos applicator (3M) was utilized for intracavitary radiation therapy. 4 MeV Linear accelerator was used for external radiation therapy.

Follow up was possible in all 35 patients. Follow up period was 9 to 34 months (average: 20 months).

We staged the patients according to FIGO (International Federation of Gynecology and Obstetrics) staging (Table 1)[3]. Staging work up included history taking, physical examination, CBC, liver function test, chest X-ray, IVP, cystoscopy and poctosigmoidoscopy. According to the patient's symptom, CT scan of pelvis and abdomen, ultrasonography, barium enema or bone scintigraphy were carried out. Of 35 patients, 4 patients were in stage I, 25 patients were in stage II, 5 patients were in stage III and 1 patient was in stage IV (Table 2). The age of the patients ranged from 32 to 70 years: median age was 53 years (Table 3).

METHODS OF RADIATION THERAPY: 35 patients of uterine cervical cancer were treated by combination of intracavitary and external radiation therapy. Radiation dose was determined by the stage of the disease and condition of the patient (Table 4). External irradiation was delivered for about 4~7 weeks. Two to three weeks after external radiation therapy, intracavitary radiation therapy was done in 1 or 2 occasions.

The reason for external irradiation before intracavitary irradiation is to improve the intracavitary radiation effect and overall treatment result by reducing the tumor size and controlling hemorrhage and infection of necrotic area. The field of external irradiation included all primary lesion and contiguous pelvic lymph nodes. Radiation was delivered through 4-field or box technic (AP, PA and 2 laterals). This technic can provide homogeneous dose distribution in tumor volume as well as less dose to bladder, rectum and small bowel to avoid complications.

Radiation machine was a 4 MeV linear accelerator for all patients. Daily dose of 180-200 rad, 5 times a week was utilized . Total dose of external radiation was 4000~6500 rad/4~7 weeks. In most patients, 4 cm midline block at depth was used after 4000 rad to reduce the dose to bladder and rectum. If 5000 rad or more was planned, shrinking fields were used.

When some residual disease was suspected shortly after completion of treatment, boost dose of 1000 rad in 5 fractions was given to the residual

Table 1. FIGO Staging of Uterine Cervical Cancer

Stage	0	Caricinoma in situ
Stage	I	Carcinoma confined to cervix
	IA	Microinvasive carcinoma
	IB	All other cases of stage I
Stage	II	Carcinoma extends beyond cervix but not to pelvic wall or lower vagina
	IIA	No obvious parametrial involvement
	IIB	Obvious parametrial involvement
Stage	III	Carcinoma to pelvic wall or lower vagina or ureteral obstruction
	IIIA	No extension to pelvic wall
	IIIB	Extension to one or both pelvic wall or ureteral obstruction
Stage	IV	Carcinoma beyond true pelvis or invading bladder or rectum
	IVA	Spread to adjacent organs
	IVB	Spread to distant organs

Table 2. Distribution of 35 Patients according to Stage

Stage	No. of patients (%)
I	4 (11)
IIA	7 (20)
IIB	18 (52)
IIIA	0
IIIB	5 (14)
IV	1

Table 3. Distribution of 35 Patients according to Age

Age (yrs)	No. of patients
30 – 35	1
36 – 40	1
41 – 45	5
46 – 50	7
51 – 55	7
56 – 60	7
61 – 65	5
66 – 70	2

Table 4. Radiation Treatment Schedule according to Stage

Stage	External R. T.	Interval (in wks.)	Intracavitary irradiation	External R. T. boost
IA			3,500rad – 3wks – 3,500rad	
IB IIA	4,000rad/4 – 5wks.	2	3,000rad – 2wks – 3,000rad	
IIB IIIA	5,000rad/5 – 6wks. Use central shield after 4,000rad.	2	2,500rad – 2wks – 2,500rad	Possibly 1,000rad in 1wk to the involved side
IIIB	6,000rad/6 – 7wks. Shrink field and central shield after 4,000rad.	2 – 3	4,000rad	
IV	6,500rad/6½wks. Shrink field and central shield after 4,000rad.	2 – 3	Possibly one application of 3,000rad	

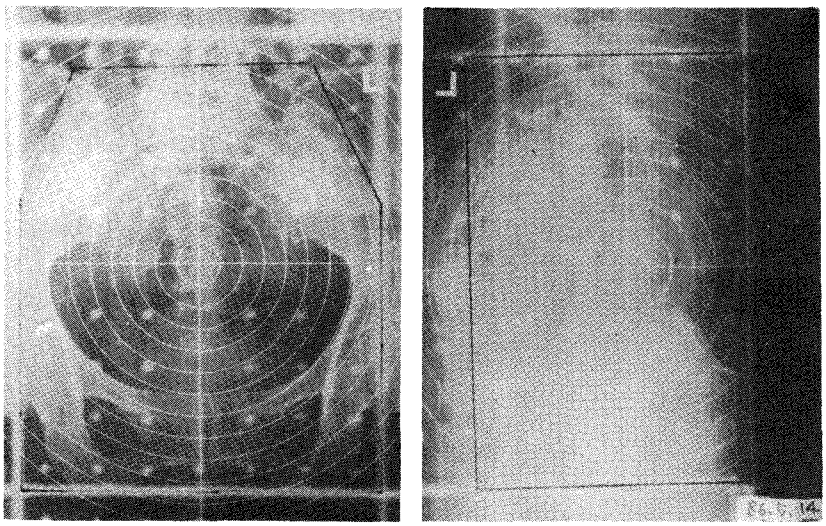


Fig. 1A, B. Reveals the AP (A, left) and lateral (B, right) fields for the external radiotherapy.

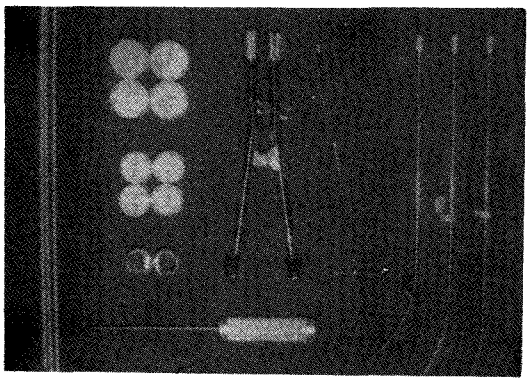


Fig. 2. Fletcher-Suit-Delclos applicator.

tumor area by external radiation therapy. The average size of AP, PA field was 16-18×15 cm and lateral one is 16-18×12 cm (Fig. 1a and 1b). The length of field was modified by the extent of the tumor infiltration.

Intracavitary radiation therapy of 35 uterine cervical cancer patients was done using the after-loadable Fletcher-Suit-Delclos applicator (Fig. 2). This applicator was made of stainless steel, with 30% less in weight compared with standard applicator. So it was convenient to handle. This applicator consists of a tandem inserted into uterine canal and 2 vaginal colpostats or ovoids inserted into lateral vaginal fornices. The size of colpostat was 1.2 cm in width, 1.6 cm in lenth and

2.9 cm in height. Tungsten shied was attached to its inner and lower ends. The colpostat could be covered with caps of 2, 2.5 and 3 cm diameter. Additional lead shield was inserted into 2 cm sized cap to reduce the radiation dose to bladder and rectum by 15-30%. The diameter of tandem was 4 mm. Tandems are available with three curvatures, 15, 30 and 45 degree angles.

Radioactive isotope in use was cesium-137. Its average energy is 662 KeV. Its half life is 30 years. The mini tube source has active length of 12 mm, physical length of 19 mm and diameter of 1.65 mm. The activity of source is expressed in "mg-Ra.. equivalent".

The insertion of intracavitary applicator was performed under spinal anesthesia. Foley catheter was inserted into bladder and bladder neck was marked with ballon filled with radioopaque dye. Rectal tube marked with lead dots was inserted into rectum. After insertion of dummy sources into the tandem, AP and lateral films were taken (Fig. 3a and 3b). The most ideal arrangement of radioactive isotope was obatined by the analysis of the computer-aided dose distribution curve.

The reference points of radiation dose are point A, point B, maximun bladder and maximum rectal doses. The idea of point A is first introduced by Tod and Meredith[4~6]. This point is important in

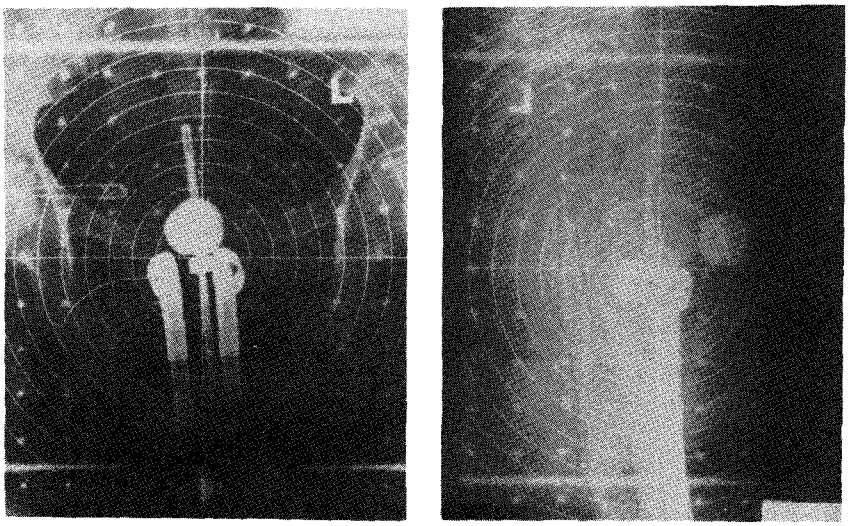
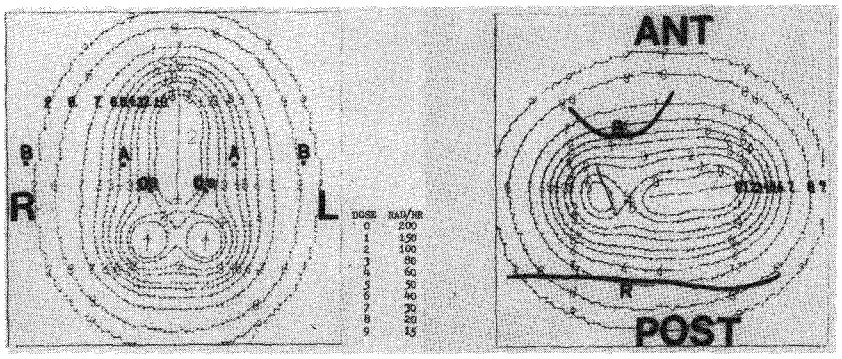


Fig. 3A, B. AP (A, left) and lateral (B, right) radiographs of the pelvis with afterloading Fletcher-Suit-Delclos cesium applicator in place.



A, B : point A, B O. S : cervical os B : Bladder R : rectum

Fig. 4A, B. AP (A, left) and lateral (B, left) showing isodose distribution in the pelvis with intracavitary irradiation.

determining the effect and complication of radiation therapy of uterine cervical cancer. Anatomically, it is the point where uterine artery and ureter cross each other and it is 2 cm above and 2 cm lateral to the uterine cervical os. Average dose rate to point A was 60~70 rad/hour. Point B is 3 cm lateral to point A. We arranged the sources so that dose to point B was about 25% of point A dose. Bladder and rectal doses were calculated at the points of maximum bladder and rectal doses respectively. Bladder and rectal doses were 50 ~60% of point A dose (Fig. 4a and 4b). Treatment time was 48~72 hours during 1 course of treatment and 1~2 course of tratment was done according to the patient's staging and condition.

RESULTS

LOCAL CONTROL: Most of the local recurrence of uterine cervical cancer occurrs within 2 years. So median follow up period of 20 months in our study is thought to be adequate to observe the local control. The local control of all 35 patients was 80% (28/35): stage I, 100% (4/4); stage IIA, 86% (6/7); stage IIB, 94% (17/18); atage III, 20% (1/5).

Recurred I patient of stage IIA received initially external radiation only because of poor economic status, and received intracavitary radation therapy after 7 months when persistent disease was noted. Another recurred patient of stage IIB refused second intracavitary radiation therapy, so insufficient irradiation was given. After 10 months of follow up, examination showed recurrence at primary site and adjacent tissue. In 5 patients of stage IIIB, 4 patients showed hydronephrosis. I patient of stage IIIB who had local control after inrradiation was initially presented with mild dilation of renal pelvis. She now survives 12 months without relapse.

No patient developed distant metastasis.

SURVIVAL RATE: Unocrrected acturarial 2 year survival rate was obtained in 35 patients by life-table method. Overall 2 year survival rate was 88 %: 100% in stage I and IIA, 94% in stage IIB and 80% in stage IIIB (Fig. 5).

COMPLICATIONS: Radiation complications in uterine cervical cancer are devided into acute and chronic. Chronic complications were diagnosed when tumors were not recurred in pelivc cavity. Chronic complications of radiation therapy in bladder and rectum occurred between 6 and 40 months after radiation therapy. Most of rectal complications were noted within 2 years[19]. Therefore, our median follow up period of 20 months was thought to be enough to observe rectal complications.

Perez classified rectal damage after radiation therapy into 3 grades[7].

Grade 1: Mild symptoms. They are relieved by sumptomatic treatment.

Grade 2: Moderate symptoms that persist, but need not to be managed surgically.

Grade 3: Severe symptoms that need surgical treatment. 8 of 35 patients showed rectal bleeding between 12 and 24 months after radiation therapy.

One of 8 patients was exculuded due to pelvic recurrence. It was difficult to differentiate postirradiation rectal complication from rectal involvement by recurrent tumor. We analyzed the remaing 7 patients. All the patients were stage II patients. 5 patients showed mild rectal bleeding intermittently (Grade 1). 2 patients showed persistent rectal bleeding with rectal tenesmus (Grade 2).

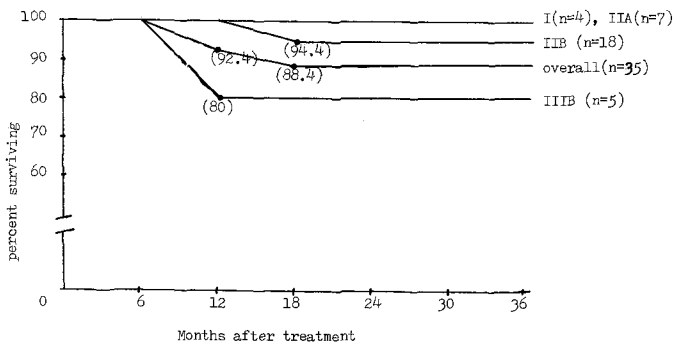


Fig. 5. Survival curve of 35 patients with uterine cervical cancer treated by external and intracavitary irradiation.

Table 5. Details of Radiotherapy for 7 Patients with Rectal Complication

No. of patients	Stage	Ext. R. T. dose (rad)	Rectal dose from intracavitary irrad max. (rad)	average (rad)	Total rectal dose (rad)	Severity of rectal bleeding	Onset of symptoms (Mo.)
1	IIA	4140	3127	2768	7267	mild, occ.*	24
2	IIA	4140	3158	2453	7298	mild, occ.*	24
3	IIB	4140	3020	3093	7160	moderate	14
4	IIB	5540	1819	1227	7359	mild, occ.*	24
5	IIB	4500	2880	2595	7380	moderate	24
6	IIB	4140	3295	2541	7435	mild, occ.*	23
7	IIB	5220	2180	2148	7400	mild, occ.*	12

occ. * : Occasionally

Table 6. Correlation between External RT and the Incidence of Rectal Complications

Ext. R. T. dose (rad)	No. of patients	Incidence
⩽4500	10	2 (1 mild, 1 moderate)
4600 – 5000	7	0
5100 – 5500	12	4 (3 mild, 1 moderate)
5600 – 6000	1	0
6100 – 6500	1	0
6600 – 7000	2	1 (mild)
>7000	2	0

Proctosigmoidoscopy was performed in these 2 patients. The findings showed the ulceration and erosion in the anterior mucosa of rectum. One of 2 patients with grade 2 rectal complication received second course of radiation therapy because of local recurrence 15 years after previous radiation therapy for the uterine cervical cancer.

The details of radiation therapy and rectal complications were summarized (Table 5). Rectal complications were observed in 7 patients. 2 patients were in stage IIA and 5 patients were in stage IIB. External radiation dose ranged from 4140 to 6500 rad. Maximum rectal doses contribut-

Table 7. Relationship between Rectal Dose and Incidence of Rectal Injury

Study group	Patient No.	No. of injury	Rectal dose (rad)	Incidence of rectal injury
Perez et al [7]	811		↓8000	5%
			↑8000	10 – 15%
Bourne et al [16]	1390	157	point A 6300	11.3% (early)
	784	28	+ 3000–3500 to whole pelvis	3.6% (late)
Kottmeier & Gray			6000	7 – 8%
			6000 – 8000	18%
			8000	26%
Yedelev et al [15]	57	12	5700	3.5%
			6900	12.2%
			8800	5.3%
Thar & Millon [19]			7000 – 7500	5 – 10%
Sohn et al	35	7	↓7000	0%
			↑7000	41% (12%)*

* Moderate rectal injury

ed by intracavitary radiation therapy were calculated by computer. The maximum values ranged from 1819 to 3295 rad. A patient who received 1819 rad had only 1 course of intracavitary radiation therapy. Total rectal dose is the sum of external radation dose and maximum rectal dose by intracavitary radiation therapy.

We analyzed the relationship between external radiation dose and rectal complications (Table 6). 2 out of 10 patients who received 4500 rad, 4 out of 12 patients who received 5100-5500 rad and 1 out of 2 patients who received 6600-7000 rad showed rectal bleeding. 2 patients who showed grade 2 rectal complication received 4500 and 5500 rad respectively. But 2 patients who received over 7000 rad did not show rectal complication (follow up period: 12 months and 16 months). So despite the small number of the patients there was no relationship between external radiation dose and rectal complications.

Table 7 shows relationship between total rectal dose and rectal complications[7,15,16,18,19]. There was no rectal complication in patients who received less than 7000 rad. But 7 out of 17 patients who received more than 7000 rad showed rectal complication and 2 out of 7 patients showed persistent rectal bleeding (grade 2). No patients showed grade 3 rectal complication. So there was a close relationship between total rectal dose and rectal complications. There was no rectal complication in 3 patients who received more than 7500 rad. But follow up period was short in these patients (9-12 months), so close observation is needed in these patients.

DISCUSSION

High local control and cure rate in uterine cervical cancer could be obtained because uterine corpus, uterine cervix and vagina tolerate high radiation dose[8]. As intracavitary radiation therapy delivers high dose to uterine cervical lesion with much less dose to adjacent normal tissue, it increases the therapeutic effect markedly in the uterine cervical cancer[8].

Intracavitary radiation therapy has been used since early 1900s. With the development of treatment method and applicatiors, cure of uterine cervical cancer is possible in more numbers of patient. Flecher-Suit applicaor which is widely used now was made in early 1950s at MDAH (M.D. Anderson Hospital). It has been continuously inproved[9,10~12]. Fletcher-Suit-Delclos applicator was made in 1970s. Compared with standard Flectcher applicator, its mini colpostats enabled to give intracavitary radiation therapy in the patients of uterine cervical cancer with narrow vagina. But lack of spacer, not like in standard Fletcher applicator which is to dilatite vaginal wall made the radiation dose to bladder, rectum and vaginal mucosa high[13,14].

The complications in pelvic cavity occur in bladder, rectum, ureter, small bowel and sigmoid colon. Early complications which occur during ratiation therapy include diarrhea, tenesmus, urinary frequency and urinary difficulty. These are relieved by symptomatic treatment. More significant is chronic complications, most of which occur 6 to 24 months after radiation therapy.

Bowel complications include enteritis, colitis, intestinal obstruction, bleeding and fistula. Perez[7] described these complications into 3 grades according to the extent of symptoms. Presently the incidence of rectal complications after radiation therapy of uterine cervical cancer was not high. Moderate to severe intestinal damage appeared 6 to 18 months after irradiation. Rectal complications occur in anterior mucosa of rectum just posterior to uterine cervix. Their occurrence is related to external radiation dose and maximum rectal dose[7,15].

Yudelev et al.[15] analyzed 57 patients of stage I B-IIIA uterine cervical cancer. They found rectal complications in 21% of the patients. 7 patients showed rectal bleeding and their average rectal dose was 5600 rad. Bourne et al.[16] analyzed chronic radiation complications in 1930 patients of uterine cervical cancer. They observed rectal complications in 3.6% of the patients. The rectal complications were not related to the radiation dose measured directly in the rectum.

High incidence of rectal damage is observed in the patients who had history of early acute side effects or previous surgery. But rectal complications are more closely related to rectal dose by intracavitary radiation therapy than external pelvic irradiation[17,18].

Kottmeier and Gray[18] described that bladder and rectal complications were related to the dose by intracavitary radiation therapy and external irradiation. The incidence of complications was 7-8% in patients when less than 6000 rad was given but it had significantly increased to 26% when more than 8000 rad was given. Similar result was shown in Perez's study. When less than 8000 rad was given, the complications were observed in

less than 5% of the patients[7].

In our study, rectal complications in 35 patients of uterine cervical cancer after radiation therapy were not related to the external radiation dose to pelvis, but significantly related to total rectal dose. Out of 17 patients who recrived 7000 rad or more, 2 patients showed rectal bleeding and no patient who received less than 7000 rad showed rectal bleeding. In our study using Fletcher-Suit-Delclos applicator, the treatment result and rectal complications of 35 patients of uterine cervical cancer were similar to other reports. Overall local control of 80% and 2 yerar actuarial survival rate of 88% were obtained. Rectal complicatons after radiation therapy was observed in 7 patients. Only 2 out of 7 patients showed persistent rectal bleeding (grade 2).

CONCLUSION

From Nov. 1983 through Feb. 1986, we analyzed 35 patients of uterine cervical cancer who were treated by external irradiation and intracavitary radiation therapy using Fletcher-Suit-Delclos applicator.

1. Stage I patients were 4; stage II, 25; stage III, 5; and stage IV, 1.

2. Age of the patients ranged from 32 to 70 years and mean age was 53 years.

3. All patients had followed up from 9 to 34 months and mean follow up period was 20 months.

4. Overall local control rate was 80% and acturial 2 year surviral rate was 88%.

5. There was a close relationship between incidence of rectal damage and total rectal dose which was the sum of external radiation dose and maximum rectal dose from intracavitary irradiation. Patients who recrived less than 7000 rad showed no rectal injury. But, 7 out of 17 patients who received more than 7000 rad showed mild to moderate (grade 1-2) degree of rectal injury. 2 out of these 7 patients showed moderate rectal injury.

From this study, we analyzed, local control rate and incidence of rectal complications are similar to other reports utilizing standard Fletcher-Suti-Delclos applicator. Therfore it seemed to be an appropriate applicator for intracavitary radiation therapy in uterine cervical cancer.

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= 국문초록 =

Fletcher-Suit-Delclos Cesium Applicator를 이용한 자궁경부암의 방사선치료

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1983년 11월부터 1986년 2월까지 Fletcher-Suit-Delclos applicator를 이용하여 강내치료와 외부방사선치료를 완치목적으로 받은 자궁경부암환자 35명을 대상으로 소급하여 치료결과를 분석하였다.

환자의 나이는 32세에서 70세까지의 분포를 보였고 평균 나이는 53세이었다. 모든 환자에서 추적조사가 가능하였다. 추적조사 기간은 9개월에서 34개월이었고 평균 추적조사 기간은 20개월이었다.

병기별로 보면 1기가 4명, 2기가 25명, 3기가 5명, 그리고 4기가 1명이었다. 전반적인 관해율은 80%이었고 2년 생존율은 88%이었다. 방사선치료후에 발생하는 합병증중 특히 직장내 합병증을 분석한 바 최대직장조사량이 7000 rad이하군에선 한명도 없었고 7000 rad 이상 조사받은 군에서는 17명중 2명에서 중간정도의 직장내 합병증이 나타났다.