Conservative Surgery and Primary Radiotherapy for Early Breast Cancer; Yonsei Cancer Center Experience

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=Abstract=

Breast conserving surgery and irradiation is now accepted as preferable treatment method for the patients with stage I and II breast cancer. Our institution activated team approach for breast conservation in 1991 and treated one hundred and fourty patients during the next three years.

Purpose: To present our early experience with eligibility criteria, treatment techniques, and the morbidities of primary radiotherapy.

Materials and Methods: Sixty four patients with early stage breast cancer who received breast conserving treatment between January 1991 and December 1992 were evaluated. All patients received partial mastectomy(wide excision to quadrantectomy) and axillary node dissection followed by radiotherapy. Total dose of 4500-5040 cGy in 5-5 1/2 weeks was given to entire involved breast and boost dose of 1000-2000 cGy in 1-2 weeks was given to the primary tumor site. Linac 4 MV X-ray was used for breast irradiation and electron beam was used for boost. Thirty five patients received chemotherapy before or after radiotherapy. Patients characteristics, treatment techniques, and treatment related morbidities were analyzed.

Results: Age distribution was ranged from 23 to 59 year old with median age of 40. Twenty-seven patients had T1 lesions and 34 patients had T2 lesions. In three patients, pathologic diagnosis was ductal carcinoma in situ. Thirty-seven patients were N0 and 27 patients were N1. There were three recurrences, one in the breast and two distant metastases during follow-up period(6-30 months, median 14 months). Only one breast recurrence occured at undetected separate lesion with microcalcifications on initial mammogram. There was no serious side reaction which interrupted treatment courses or severe late complication. Only one symptomatic radiation pneumonitis and one asymptomatic radiation pneumonitis were noted.

Conclusions: Conservative surgery and primary radiotherapy for early breast cancer is proven to be safe and comfortable treatment method without any major complication. Long-term follow up is needed to evaluate our treatment results in terms of loco-regional control rate, survival rate, and cosmetic effect.

Key words : Breast Cancer, Breast-conserving therapy

INTRODUCTION

Over the past several decades, many prospective randomized trials and retrospective single institution studies with large number of patients were performed to compare breast conservation surgery with total mastectomy[1-9]. These studies confirmed that partial mastectomy, followed by breast irradiation in all patients and adjuvant chemotherapy in women with positive nodes, is appropriate therapy for Stage I and II breast cancer. Outcome of patients who received breast preservation therapy absolutely relates to the expertise of the surgeon, pathologist, and radiation and medical oncologists. Sophisticated care that will result in a satisfactory cosmesis and control of disease in the breast is more complex than is necessary for carring out a mastectomy. Therefore, harmonious team approach is mandatory in breast conserving treatment.

In this country, the practice of conservative treatment for early breast cancer has not been generalized yet. Since 1991, our institution activated team approach for breast conservation treatment. We have expersienced about one hundred and fourty patients with early breast cancer treated by conservative surgery and primary radiotherapy for the next three years. We will present our early experience with treatment techniques and morbidities of primary radiotherapy.

METHODS AND MATERIALS

Sixty four patients with early breast cancer received primary radiotherapy after breast conserving surgery at Department of Radiation Oncology, Yonsei Cancer Center between January 1991 and December 1992. All patients had received thorough physical examination of the breasts and mammographic evaluation with or without ultrasonography. Patients were eligible for breast conservation treatment if the tumor, either single or multiple, was confined to one quadrant of breast and not larger than 5 cm in largest dimension. In addition, tumor had to be movable in relation to the skin, underlying muscle, and chest wall, with no clinical evidence of skin involvement. Axilla should be free of palpable or mobile nodes.

Conservative Surgery

All patients received partial mastectomy along with axillary lymph node dissection. Extent of surgical resection of primary tumor was variable according to a surgeon's preference from lumpectomy, wide excision to quadrantectomy. When wide excision was employed, only the amount of normal breast tissue was removed which was sufficient to ensure that the margins of the resected specimen were free of tumor. In the cases with no definitely palpable lesion or ill defined mass, localization technique with an aid of diagnostic radiologists was used. As an effort to obtain a negative margin of primary tumors, frozen biopsy was performed during operation. After obtaining a specimen, marking the orientation and inking were done before fixation. All resected specimen were examined histologically to ensure that the margins were free of tumor. Microscopic confirmation of primary breast carcinoma with measurement of carcinoma size was done. Histologic type, histologic grade, nuclear grade, EIC(extensive intraductal component), and the presence or absence of gross or microscopic carcinoma at the margin were also assessed histopathologically. ER and PR receptor analysis was also done.

Primary Radiotherapy

Radiation therapy was begun 4–18 weeks(median 5 weeks) after operation. Some patients received one to three cycles of chemotherapy before radiation. Post-operative, pre-radiotherapy mammography was done in all patients to rule out residual disease and as a baseline study for follow-up. Irradiated volume was involved breast alone or breast and supraclavicular fossa in most patients. Only the patients with 4 or more positive axillary lymph nodes received

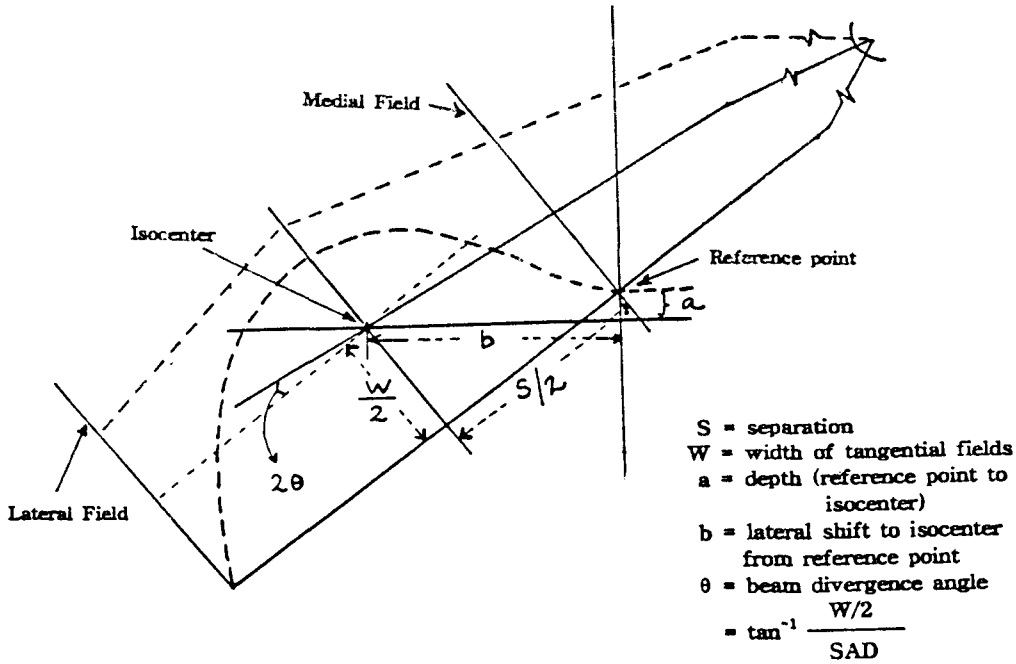

Fig. 1. Isocentric set up of the breast tangential fields. Locating the isocenter can be done by upward (a) and lateral shift (b) of the table from reference point over solid central tissue. Posterior tilting (0°) of the tangential beam eliminates its divergence into the lung tissue.

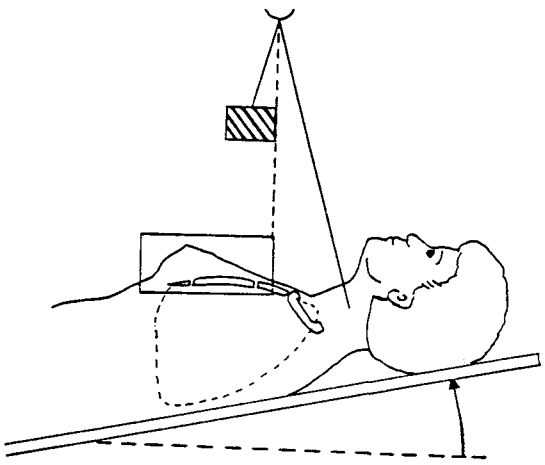

Fig. 2. Use of a tiit board to making the tangential field paralled to the chest wall also facilitates junctional adjustment between breast field and half beam of supraclavicular field.

supraclavicular fossa irradiation. As our patients received proper axillary node dissection, irradiation of axillary fossa with or without posterior axillary boost was rarely applied. Breast irradiation was done with opposed tangential fields with SAD technique(Fig. 1). To reduce the dose to the lung, beam divergence of medial and lateral breast tangential fields were aligned by posterior tilting of gantry(Fig. 1). To compensate sloping surface of the breast, appropriate wedges were used. Bolus was not applied. Inclined breast board was used to adjust chest wall and to flatten the breast(Fig. 2). Elimination of collimator rotation of tangential breast fields facilitated junctional adjustment between breast field and supraclavicular field. Junction between breast field and supraclavicular field was matched by half-beam of supraclavicular field and rotation of treatment couch(Fig. 3). Linac(linear accelerator) 4 MV X-ray was used to treat entire breast and supraclavicular fossa. For primary site boost, 9-15 MeV electron beam was used. Selection of electron beam energy was de-

Table 1. Patients Characteristics

Age	No. of Patients	Pathology	No. of Patients
—29	6	DCIS	3
30—39	25	Invasive Duct Carcinoma	58
40—49	26	Medullary Carcinoma	2
50—59	7	Colloid Carcinoma	1
Stage (AJC)			
Tis	3	NO	37
T1	27	N1	27
T2	34	1—3	14
2—3cm	22	4—9	6
3—4cm	5	10<	7
4—5cm	7		
0	3		
I T1NO	17		
IIA	27		
T2NO	17		
T1N1	10		
IIB T2N1	17		

DCIS; Ductal Carcinoma In Situ

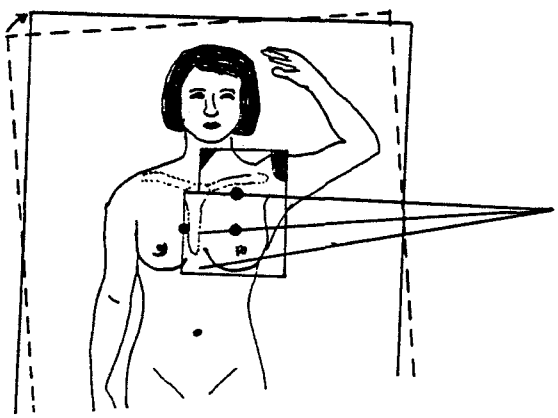

Fig. 3. In order to eliminate the divergence of the tangential field from entering the supraclavicular field, the treatment couch is rotated 5—6° and the divergence of tangential field is made paralled to the supraclavicular border. The dashed line represents the table in its unrotated position.

termined with an aid of planning CT scan. Total dose of 4500–5040 cGy with daily fractionation of 180–200 cGy was given to entire involved breast and boost dose of 1000–2000 cGy in 1–2 weeks was given to the primary tumor site. In the cases with positive or close resection margin, total dose to primary tumor site was increased to 6500 cGy and in the cases with negative margin, total dose was 6000 cGy.

Chemotherapy

Thirty five patients with positive axillary lymph nodes or poor prognostic factors such as high nuclear grade or histologic grade received chemotherapy in combination with radiotherapy. Most of them(30/35) received one or three cycles of chemotherapy before radiotherapy. Chemotherapy regimen was CMF (cyclophosphamide, methotrexate, 5-fluorouracil) or FAC (cyclophosphamide, adriamycin, 5-fluorouracil). In the patients with 4 or more positive axillary lymph nodes received 3 cycles of FAC before radiotherapy. We didn't apply chemotherapy concomitantly with radiation.

Follow-up method

The patients were followed every 3 months for 2 years. Post-radiotherapy mammogram was taken at 6 months after RT and annually thereafter.

RESULTS

Patients cnaracteristics are summarized in table 1. Age distribution was 23 to 59 year old with median age of 40. In three patients, pathologic diagnosis was ductal carcinoma in situ. Remained sixty one patients were invasive carcinoma with mostly invasive duct carcinomas. Twenty-seven patients had T1 breast lesions and 34 patients had T2 breast lesion. Two patients had multiple lesions in the same quadrant of breast. Laterality was almost equally distributed with 33 right breast lesions and 31 left breast lesions. Most lesions were located on upper outer(32

cases) or upper inner quadrants of breast(22 cases). Four cases located in lower inner quadrant, three were in the lower outer quadrant, and three were in upper central area. Total number of axillary nodes dissected were 7–43 with median number of 19. Thirty seven patients were N0. In 14 patients, one to three axillary lymph nodes were involved with disease and four or more lymph nodes were involved in 13 patients. After partial mastectomy, pathologic examination revealed microscopic tumor infiltration on resection margins in six patients. They are all free of disease 16 to 30 months after radiotherapy.

All patients were followed up for 6–30 months (median 14 months). During follow-up period, one patient experienced ipsilateral breast recurrence and two patients developed distant metastases. The patient with breast recurrence was 33 year old women at diagnosis of breast cancer. She was presented with palpable lumps in her left breast. She had been referred from outside hospital for operation after mamm-ographic evaluation. She had two separate masses, which sizes were 1.2 cm and 2.0 cm in largest dimension, in upper inner quadrant of left breast. She had received lumpectomy and axillary lymph node dissection. Microscopic examination revealed negative resection margin, histologic grade II, nuclear grade II, and positive EIC. Twenty four dissected axillary lymph nodes were negative for malignancy. Breast irradiation with 45 Gy on entire breast and 16 Gy of electron beam boost was done 7 weeks after surgery. Chemotherapy with CMF regimen was given one cycle before and five cycles after radiotherapy. Fourteen months after operation, about 1 cm sized nodule with multiple micro calcifications was detected on routine follow-up mammogram without any symptom or palpable lump. Location was upper outer quadrant and outside of previous boost radiation field. Retrospective review of initial pre-operative mammography taken outside hospital revealed tiny nodular density with some microcalcification at same location as newly found lesion. We missed that separate lesion at initial diagnosis. After confirmation of recurrent cancer by excisional biopsy, total mastectomy was performed. Now she is free of disease 10 months after recurrence. The other patient with distant metastasis was 36 year old woman with stage T2N2 M0 breast cancer. Because eighteen out of twenty four dissected axillary lymph nodes were involved with carcinoma, two cycles of chemotherapy with FAC regimen was performed before radiation, after quadra-ntectomy and axillary lymph node dissection. Radiotherapy was begun 9 weeks after surgery. Three weeks after beginning of radiation, patient complained of low back pain and newly developed hot uptake on 3rd lumbar vertebral body was noted on radioisotope bone scan which was normal 4 months before, at diagnosis. Plain X-ray also revealed bony destructive change with compression fracture of 3rd lumbar vertebral body suggesting bone metastasis. She received 3000 cGy of palliative radiotherapy on lumbar spine. Now she is on chemotherapy without further progression or local recurrence. Another 23 year-old patient with T2N0 breast cancer revealed pulmonary metastasis at 10 months after radiotherapy without evidence of loco-regional recurrence.

All patients tolerated well to radiation. There was no serious side reaction which interrupted treatment courses. All patients experienced various degree of skin reaction with mostly Grade I reaction by RTOG acute radiation morbidity scoring criteria(follicular, faint or dull erythema/ epilation/ dry desquamation/ decreased sweating). Six patients suffered from RTOG grade II skin reaction(tender or bright erythema, patchy moist desquamation/ moderate edema), but resolved uneventfully within a month. There was a trend that Grade II skin reaction was more common in the patients who received chemotherapy before radiation(4/30) than the patients who did't recieve chemotherapy(2/33).

During follow-up period, no severe complication was identifiable. Radiation pneumonitis was

noted in two patients. One patient with a largest CLD(central lung distance), 4 cm, suffered from symptomatic radiation pneumonitis which resolved two months later and in the other patient who received radiation on supraclavicular fossa, pneumonic consolidation on irradiated lung apex was noted on chest PA film taken one month after radiotherapy asymptomatically.

DISCUSSION

Although breast conserving surgery and irradiation is now considered as preferable treatment method for the patients with stage I and II breast cancer, some controversial issues regarding patients eligibility, radiotherapy techniques such as radiotherapy volume , necessity of boost , optimum combination of chemotherapy, have not been solved yet.

Patients Selection

To define the patients eligibility, we should consider factors affecting breast recurrence and cosmetic results, as the aim of breast conserving treatment is tumor control with acceptable cosmesis. Breast recurrence following conservative surgery and radiation is most likely related to the presence of a significant residual tumor burden following excisional biopsy that can not be controlled with modest dose of radiation[10,11]. Therefore, to reduce the local recurrence after conservative treatment, careful patient selection and proper surgical management before radiation are mandatory. The most important steps to select the patients are thorough physical examination of breast and mammographic evaluation before surgery to rule out gross multifocal or multicentric disease, careful review of pathologic material to assess resection margin, and specimen mammography and post-operative mammography after partial mastectomy to confirm the removal of disease[12].

The patients with gross multifocal disease or diffuse mammographic microcalcifications have higher chance of having residual tumor burden in the remained breast and increased risk of breast recurrence[13,14]. In this series, only one breast recurrence at time of this writing was occurred in the patient with multiple masses and recurrent mass was mammographically neglected microcalcification at the time of initial surgery. Therefore, high quality mammographic evaluation is very important and might reduce breast recurrence. However, multifocal disease confined to one quadrant of the breast which is feasible for excision without disfiguring the breast is still eligible for breast preservation in most institutions as well as our hospital.

Large tumor size more than 3-4 cm is not an absolute contraindication for breast-conserving treatment because tumor size, T1 or T2, didn't affect breast recurrence rate or survival in most large series[1,2]. But large tumor in small breast in which adequate resection would result in significant cosmetic alteration can be a relative contraindication.

Another important factor affecting breast recurrence is resection margin[11]. Many authors reported that microscopically positive or close resection margin(tumor within 2 mm of margin) was correlated with increased recurrence. The others suggest that there was no increased breast recurrence in positive or close margins if they received higher boost dose[15]. Although wide negative margin resulted in lower breast recurrence even without boost dose, excessive loss of breast tissue gave adverse effect on cosmesis. Therefore, excision with rim of a grossly normal tissue, avoiding excessive sacrifice of breast tissue is recommendable. In order to obtain a negative resection margin without excessive sacrifice of normal breast tissue and achieve better cosmesis, mammographic localization of the lesion, especially in the non-palpable, mammographically detected lesion, frozen section of the margin, and specimen mammography would be helpful. Guideline and techniques for examining the specimen can be found elsewhere in the literature[12]. Although some authors advocate re-excision in the cases with positive

margin or uncertain margin, we tried radiotherapy with higher boost dose in the cases with microscopically positive margins.

Surgical Consideration

The purpose of surgery in breast-conserving treatment is to remove the tumor grossly with minimal cosmetic deformity. Nomenclature of conservative surgery in the literature is rather confusing, but following terms were established at a consensus conference in 1985[16]. Excision (tumorectomy, lumpectomy) indicate removal of the tumor grossly without attention to margins . Wide excision (limited resection, partial mastectomy) indicate excision of the tumor with grossly normal clean margins and quadrantectomy is en-bloc excision of the tumor within a quadrant of breast tissue along with the pectoralis major muscle fascia and overlying skin. As mentioned before, extent of surgical resection is closely correlated with breast recurrence and cosmesis, optimization of surgical resection according to breast size and location and size of tumor is crucial for better cosmesis. Recently, most contributers advocate a wide excision because simple excision may result in a somewhat higher risk of breast recurrence when compared to wide excision, and quadrantectomy clearly results in less optimal cosmesis due to the volume loss while not significantly reducing the risk of a breast recurrence when compared to wide excision.

Along with partial mastectomy, level I to II or full axillary dissection is recommended for all invasive cancer patients. The purpose of axillary dissection is to use the information obtained relative to lymph node involvement with tumor, for determining prognosis for staging relative to the use of adjuvant chemotherapy, and for local regional disease control.

Radiotherapeutic Consideration

The purpose of radiotherapy in the breast-conserving treatment is to eradicate the residual microscopic cancer with moderate dose of radiation with preserving the good cosmetic result. Therefore, standardized radiotherapy technique with optimum radiation volume and dose is essential. Reproducible patient set-up and simulation, sophisticated treatment planning with use of tissue compensator to improve dose homogeneity, and supervoltage equipment with 4, 6, or 8 MV X-ray or Co-60 are generally employed. As the greater the energy, the better the homogeneity and more skin sparing, 6 MV X-ray is the best compromise in terms of radiation dose homogeneity and skin dose[17,18]. Sometimes, higher energy photon(10 MV X-ray) with beam spoiler is indicated for very large breast which was considered as contraindication when 4 MV X-ray or Co-60 was used for breast irradiation. Various kind of wedges are generally used for tissue compensator. At some institutions, a single large lateral wedge is used, rather than smaller medial and lateral wedges in order to reduce the dose to the opposite breast, which is greatly influenced by the presence of a medial wedge, but this increase the asymmetry of dose distribution. Less than 10 % of dose inhomogeneity within the target volume at the plane through the central axis is generally accepted, but dose inhomogeneity off the central axis is more than this, about 20 % due to significant alteration of breast anatomy[19]. Recently, three-dimensional treatment planning with an aid of CT scanning was attempted to improve dose homogeneity[17]. However, the impact of this recent development on patient outcome has not been determined.

Total dose of 4500 to 5000 cGy with daily dose of 180 to 200 cGy to entire involved breast with or without boost dose to the primary site is generally accepted for control of subclinical disease or microscopic residual disease in the remained breast tissue. There is no universal agreement about the need for a radiation boost dose to the primary site. It is likely that a boost is more important after limited surgery than after very wide excision or quadrantectomy, because the closer to the primary tumor, the larger tumor burden will be lo-

cated[20]. We employed a boost for all patients regardless of surgical extent or margin status. However, we agree the opinion that patients with wide negative margin may not benefit from a boost, particularly in the absence of an EIC. Also, in the patients with microscopically positive or close margin, wider volume and higher dose of boost is recommendable[15].

Although, there is a lack of consensus concerning the need for irradiation of regional lymph -node bearing area, there is agreement in the need to avoid axillary irradiation after a complete axillary dissection because not only axillary node recurrence rate after axillary dissection is negligibly low but also axillary irradiation add morbidity such as arm edema, breast edema, and brachial plexopathy[18,21,22,23,24]. In the NSABP B-06 trial and Milan trial in which axillary irradiation was not performed after axillary dissection even in node positive patients, regional recurrence was very low ranging from 2.3% to 4.5%[1,25]. These findings support consideration of omission of regional node irradiation in patients with positive axillary nodes. In the report from JCRT, regional nodal failure was the first site of failure for 38 of the 1,624 patients[26]. The incidence of axillary failure for patients undergoing axillary dissection who were irradiated to the breast only was 2.1 % for both patient group with negative nodes or positive nodes. The incidence of supraclavicular failure in these two groups was 1.9% and 0%, respectively. They concluded that regional nodal failure is uncommon in patients treated to the breast alone following an adequate axillary dissection and proposed that axillary or supraclavicular irradiation should not routinely be given following adequate axillary dissection when the nodes are negative or only one to three nodes are positive. There are insufficient data at present to justify firm recommendations regarding axillary and supraclavicular irradiation for patients with four or more positive nodes. Currently, we don't irradiate axilla after axillary dissection even in node positive patient and irradiation of supraclavicular fossa is employed only in the patients with four or more positive axillary lymph nodes. Also, we are not concerned about internal mammary lymph nodes.

Morbidities

Because follow-up period in this series is not enough to evaluate treatment outcome in terms of breast recurrence, survival, cosmesis, or late complication, we could only mention about observed side reactions during irradiation and shortly after irradiation. Skin reaction and breast edema were identified in some patients during irradiation and radiation pneumonitis was noted in a few patients after radiation. All of the patients experienced various degree of skin reaction, but most skin reactions could be categorized as grade I by RTOG criteria. Skin reaction was more common and more severe in the patients who received chemotherapy prior to radiotherapy.

Breast edema was experienced in about half of patients who received breast-conserving treatment and severity of breast edema is correlated with extent of axillary dissection and axillary irradiation. Usually breast edema progresses during irradiation and subsides gradually after radiotherapy, but mild breast edema can be remained in fourteen percent of patients at 5 years after treatment[27].

Symptomatic radiation pneumonitis is an uncommon complication after irradiation for breast cancer. At the JCRT, 10 of 928 patients(1%) treated for early breast cancer with primary radiotherapy developed symptomatic radiation pneumonitis[28]. The likelihood of radiation pneumonitis was increased when supraclavicular fossa was irradiated, chemotherapy is combined, and large volume of lung was included in the irradiated volume. In order to minimize the risk of radiation pneumonitis, lung volume treated in the tangential fields should be limited by keeping the perpendicular distance at the isocenter from the deep field edges to the posterior chest wall(central lung distance=CLD) to 3cm or less. In the current study, one patient with largest CLD and received chemotherapy experienced symptomat-

ic pneumonitis and one patient received supraclavicular fossa irradiation and chemotherapy revealed asymtomatic radiographic changes on lung apex.

In the past, the most frequent complication of radiotherapy for breast cancer was arm edema. The incidence of arm dema was 20% to 25% and more common in the patients who received both axillary surgery and radiation than the patients received axillary surgery alone. Elimination of axillary irradiation after axillary dissection markedly reduced the incidence of arm edema[22, 23]. In this series, there was no arm edema or brachial plexopathy during follow-up period.

CONCLUSION

As our experience is limited due to short follow-up period, it is hard to evaluate our treatment results in terms of recurrence rate, recurrence pattern, survival rate, and cosmesis. However, it is proved that primary radiotherapy after conservative therapy is safe and comfortable treatment modality without any major acute or subacute complication. Also, through the result that only one breast recurrence was due to patient selection fault, it is confirmed that thoroughful assessment of eligible patients is very important, essential process to achieve better local control.

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국문초록 =

조기 유방암에서 보존적 수술후 방사선치료: 연세암센터 경험

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병기 1기, 2기 유방암에서 유방보존적 수술 후 방사선치료는 기존의 유방전적출술을 대치할 수 있는 치료법으로 정립되었다. 연세암센터에서는 1991년 부터 유방보존술을 적극적으로 시행하였고 첫 3년 동안 140예를 치료하였다.

목적 : 연세암센터에서 시행하고 있는 유방보존술의 적응증, 치료방침과 방사선치료 방법을 소개하고 결과 및 방사선치료의 부작용을 보고하고자 한다.

방법 : 1991년 1월부터 1992년 12월까지 연세암센터 치료방사선과에서 유방보존적수술 후 근치적 방사선치료를 받았던 64명의 조기 유방암 환자를 대상으로 하였다. 모든 환자들은 종괴 또는 병변을 포함한 부분유방절제술과 액와임파절 곽청술을 시행받은 후 방사선치료를 받았다. 방사선치료는 수술후 3-18주에 시행되었는데 선형가속기 4MV X-ray를 사용하여서 침범된 유방 전체에 4500-5040 cGy를 5-6주에 걸쳐서 조사하였고 원발 병소 주변에 전자선을 사용하여서 1-2주에 걸쳐서 1000-2000 cGy를 추가 조사하였다. 치료를 받았던 환자들의 임상적 특성과 치료방법, 방사선치료에 따르는 부작용, 재발 여부 등을 분석하였다.

결과 : 대상환자들의 연령은 23세에서 59세로 중앙값이 40세 였다. 총 64명중 T1은 27명, T2는 34명 이었으며 3명은 비침윤성 암이었다. 또한 전체의 42.2%인 27명은 액와임파절 침윤이 있었다. 추적 기간(6-30개월, 중앙값 14개월) 동안 1예의 유방내 재발과 2예의 원격 전이가 관찰되었는데 유방내 재발은 원발병소와 다른 사분원에 위치하여서 처음 진단에서 발견하지 못했던 유방조영술상의 미세석회화음영에서 종괴가 자랐던 예로 다시 유방전적출술을 받은 후 무병생존 중이다. 방사선치료 중 또는 추적 기간 동안 치료를 요하는 부작용으로는 1예에서만 방사선 폐렴이 있었으나 대증요법 으로 완쾌되었다.

결론 : 추적 기간이 짧기 때문에 국소재발율, 생존율, 미용효과 등의 치료 결과를 평가하기는 이르지만 조기 유방암에서 유방보존적 수술과 근치적 방사선치료는 심한 급성 또는 아급성 부작용이 없는 안전하고 편안한 치료법임을 확인할 수 있었다. 또한 국소재발율을 낮추기 위해서는 유방보존술에 적합한 환자들을 선택하기 위한 철저한 평가가 필수적임을 알 수 있었다.