

전이성 뇌종양에서 방사선치료의 역할*

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= Abstract =

Role of Radiation Therapy in the Treatment of Brain Metastases

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Brain metastases are a common cause of disability and death in patients with cancer, but their management remains a major clinical problem. They can, however, be effectively controlled by radiation therapy, possible modalities being external radiotherapy, brachytherapy(implantation), stereotactic radiosurgery(SRS), or a combination of the above modalities. It can be expected that the neurologic status of patients thus treated will remain stable or improve for most of the period during which they survive ; using whole brain radiotherapy, the possible palliation index is 75 - 80%. Despite treatment, however, as many as 1/3 to 2/3 of patients are expected to die from complications related to the progression of brain metastases. With regard to survival, randomized trials involving dose escalation have not yet shown any advantage over the conventional dose ; the same palliation index of 75 - 80% is expected for 40Gy/20 fractions, 30Gy/10 fractions, and 20Gy/5 fractions. It is clear, however, that a smaller daily dose of radiation(the conventional dose is 200cGy/fraction) will reduce the incidence of radiation induced dementia and improve the quality of life in long term survivors. In certain conditions such as solitary brain metastasis without extracranial disease and good performance status(KPS 70), a more aggressive approach, including surgical resection and stereotactic radiosurgery can be considered.

KEY WORDS : Brain metastasis · Radiation therapy · Radiosurgery · Brachytherapy.

서 론

4).
 (1) : (performance status)
 (2) :
 14 63%가 1)2), 33
 5 20%
 66% 가 (3) 가 :
 40 50% 1)2), (4) (histology) :
 3). 가 가
 4). 가 가 1) 가
 1997 Symposium 가

3
 1)
 (external beam radiotherapy), 2)
 (brachytherapy), 3)
 (stereotactic radiosurgery), 4)

**RTOG 연구들의 고찰 :
 방사선 조사방법 및 예후인자**

1970 Radiation Therapy Oncology Group
 (RTOG) 가
 (Table 1)⁵⁾⁶⁾
 (response rate) (duration
 of response) 가 15
 18 가
 400cGy/fraction(fx)(2000cGy/1) 2
 가 64% 300cGy
 /fx 54%
 (palliative index)
 75 80%
 20%
 (radia-
 tion modifier) 가 . Komarnick
 (RTOG 79 - 16) (hypoxic cell
 sensitizer) misonidazole 30Gy

Table 1. Results of first two studies by RTOG in brain metastases

Trial	Pt's No	RT Dose	Results
RTOG			
1st (1977)	910	40Gy/4wks	1) no diff. in duration of response, & response rate(10 - 12W/00)
		40Gy/3wks	2) responded more quickly in patients with shortest fx re-
		30Gy/3wks	3) overall median survival :
		30Gy/2wks	
2nd (1980)	1001	40Gy/3wks	18 wks(1st), 15wks(2nd)
		30Gy/2wks	4) Ultra-rapid high dose arm :
		20Gy/1wk	10Gy/1fx(1st) & 12Gy/2fx(2nd) more rapid response but short duration of response

가⁷⁾.
 label -
 ling index proliferation rate
 BrdUrd 가
 (Cho⁸⁾)

(Table 2)⁹⁾.

Diener - West RTOG
 (Karnofsky performance status) 70
 , 60
 가

10).
 가 (Table
 3). 가 RTOG 3 가

11).
 (Table 4)¹²⁾¹³⁾¹⁴⁾¹⁵⁾.

Swift
 13). 4 가 가 4
 가
 50% 21%
 가
 (altered hyperfractionation)
 1

Table 2. Biological modification of radiotherapy

	30Gy/10fx		30Gy/6fx	
	misonidazole (-)	misonidazole (+)	misonidazole (-)	misonidazole (+)
Komarnicky (RTOG 79 - 16, 1991)				
median survival	4.5mo	3.9mo	4.1mo	3.1mo
Philips et al (RTOG 89 - 05, 1995)	RT alone (37.5Gy/15fx)		RT with BrdUdr (0.8g/m ² /d for 4 days)	
median survival	6.12mo		4.3mo	
complete response rate	12%		27%	

*no statistically significance

Table 3. Survival difference by prognostic factors(Diener-West et al : RTOG 79 - 16, 1989)

Favorable prognostic factor*	200 days Survival	Median Survival
4 / 4(+)	52%	7.4mo
3 / 4(+)	38%	5.0mo
2 / 4(+)	24%	3.3mo
1 / 4(+)	18%	2.6mo
0 / 4(+)	8%	1.8mo

*Karnofsky performance status >70, Age <60, Metastatic disease limited to brain, controlled primary tumor.

Table 4. Favorable prognostic factors

Gelber et al ⁸⁾	Ambulatory breast ca. with no soft tissue metastasis
	Ambulatory lung ca. with absent primary or no extracerebral metastasis
Diener-West et al ⁶⁾	KPS >70
	Absent / controlled primary tumor
	Age >60 yrs
	Metastatic spread limited to the brain
Swift et al ⁹⁾	Less than four lesions on the initial CT scan
	Absence of mid-line shift
Chatani et al ¹⁰⁾	In lung ca : normal LDH level, good PS*
Harwood et al ¹¹⁾	Solitary brain metastasis
	No extracerebral metastasis
	Breast rather than lung primary
	Good PS

*PS = performance status

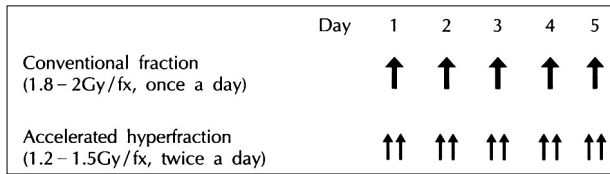


Fig. 1. Scheme of Radiotherapy fractionation.

Table 5. Result of accelerated hyperfractionated radiotherapy(RT-OG 85 - 28)

	48Gy	54.4Gy	64Gy	70.4Gy
Median survival	4.2mo	5.3mo	4.8mo	6.4mo
1yr survival rate	13%	31%	27%	31%

S	Primary Site	R	Arm 1 :
T	beast	A	30Gy/10fx/10 days,
R	lung	N	3Gy/fx to include the
A	other & unknown primary	D	whole brain
T	Extent of Disease	O	
I	brain only, primary controlled	M	VS
F	/absent	I	Arm 2 :
Y	brain only, uncontrolled primary	Z	54.4Gy/34fx/17 days,
	brain plus other site, primary	E	1.6Gy/fx
	controlled/absent		(32Gy/20fx/10 days
	Number of brain metastases		to whole brain &
	single		22.4Gy/14fx/7 days
	multiple		boost)

Fig. 2. Treatment schedule of RTOG 91 - 64 trial.

(Fig. 1).

(repopulation)

1

가

가

가

RTOG 1 2 RTOG 85 - 28

32Gy(1.6Gy/fx, 1 2)

가

가

16)

48 Gy, 54.4Gy, 64Gy, 70.4Gy

가

52%

1 48Gy 54.4Gy 59 21

가 54.4Gy

(Table 5).

RTOG 91 - 04 가 (Fig. 2).

수술후 방사선치료의 역할

가 가

13)15).

가 가

17). Kentucky

48

18). 36Gy/10fx

11%

가

15 40

가

20%, ()

가

19)20)21).

가

5

가

가

가, Mayo clinic
 (Table 6)²²⁾.
 가 가
 가
 2
 Memorial Sloan Kettering Cancer Center(MSKCC)
 가 (Table 7)²³⁾²⁴⁾.
 1 11%
 300cGy/
 fx
 가

Table 6. Result of Mayo study for effect of postoperative whole brain radiation(1992)

Group	Complete resection	Systemic disease	median survival		1YSR		2YSR	
			RT		RT		RT	
			(+)	(-)	(+)	(-)	(+)	(-)
1	yes	no	16mo	9mo	70%	34%	41%	19%
2	no	no	13mo	3mo	60%	0%	30%	0%
3	no	yes	8mo	3mo	42%	15%	20%	15%
4	yes	yes	8mo	5mo	35%	25%	15%	15%

Table 7. Results of MSKCC trials(postoperative whole brain radiation)

1st study(1989)			
	RT(+)	RT(-)	
Median survival	20.6mo	14.4mo	not signif. diff.
1yr survival rate	48%	47%	
2nd study(1994) : Lung ca. without previous cranial RT			
	Group A*	B**	C***
5yr survival rate	12%	8%	16%
Med. survival	14mo	10mo	15mo
Focal failure	34%	23%	
Other intracranial mets	9%	21%(p = 0.07)	

*without postoperative whole brain radiation
 **with postoperative whole brain radiation and prognostically matched to group A
 ***all other postoperative whole brain radiation

뇌정위적 방사선수술(Radiosurgery)

0.5 1mm
 (focused X - ray beam)
 가
 가 Alexander
 1 2
 85%, 65%²⁵⁾
 Flickinger
 116
 65²⁶⁾
 (81.2 ± 8.1% vs 52.9 ± 11.9%, p = 0.004)
 RTOG(95 - 08)
 가가
 (Fig. 3).

근접방사선치료(Brachytherapy)

(malignant glioma)
 (Karnofsky)
 70 , 가 5cm ,

S	Number of Metastases	R	Arm 1 :
T	single	A	whole brain RT to
R	multiple	N	37.5 Gy/15 fx, 2.5 Gy/fx
A		D	once daily, 5 days/week
T	Extent of Extracranial Disease	O	followed by
I	none	M	radiosurgery to all(1 - 3) mets
F	present	I	VS
Y		Z	Arm 2 :
		E	whole brain RT to
			37.5 Gy/15 fx, 2.5 Gy/fx
			once daily, 5 days/wk

Fig. 3. Treatment protocol of RTOG 95 - 08 trial.

가) Iodine - 125(Iridium - 192
12 18 27)28)29).

palliation index 75 80% .
2/3 가 가
가 (; 200cGy/fx) 가

가
방사선 재치료(Reirradiation)

2/3 15% 가 30). 42
74% 31 - 34) 3.5 5

부 작 용

2 3 (dry desquamation) , , (steroid), , (myelosuppression) 1 4 (somnolence syndrome)

요 약

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