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President's Special Session

**LOW-LEVEL RADIATION AND ITS
IMPLICATIONS FOR FUKUSHIMA RECOVERY**

Radiation Oncology

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Summary



- ◆ Starting in 1975, I carried out fundamental research on low-dose radiation effect on tumor-bearing mice
- ◆ Then clinical studies on cancer patients: 1985-2000
- ◆ Total- or half-body low-dose radiation treatments to ~ 200 patients to cure cancer / prevent recurrence.
- ◆ **LDR Dose: $10 \times 150 \text{ mGy} = 1500 \text{ mGy} (150 \text{ rad})$**
- ◆ Based on my experience in treating many patients, radiation level near Fukushima is not cancer risk

My Background

- ◆ Medical Instructor, Radiology, School of Medicine, U of Tokyo 1964-66
- ◆ Research Fellow, NIH-NCI, M.M. Elkind's Lab, Bethesda, MD, USA 1966-68
- ◆ Research Associate, Gray Laboratory, H.B. Hewitt's Lab, London UK 1968-69
- ◆ Assoc Professor, Rad Research, Tohoku U, School Medicine, Sendai 1969-72
- ◆ Assoc Professor, Dept Rad Biophysics, Faculty of Med., U of Tokyo 1972-81
- ◆ International cooperation UBC Triumpf Lab, Canada, pi-meson therapy 1975-78
- ◆ UC Berkeley, USA, heavy-ion cancer therapy 1978-81
- ◆ Professor, Dept Rad Research, Tohoku U, School Medicine, Sendai 1981-86
- ◆ Professor, Dept Radiology, Tohoku U, School of Medicine, Sendai 1986-96
- ◆ Director, Tohoku Radiological Sciences Center, Sendai, 1996-2001
- ◆ Chairman, Board of Directors, Tohoku Rad. Sci. Center, Sendai, 2001-2012
- ◆ Academies and Societies

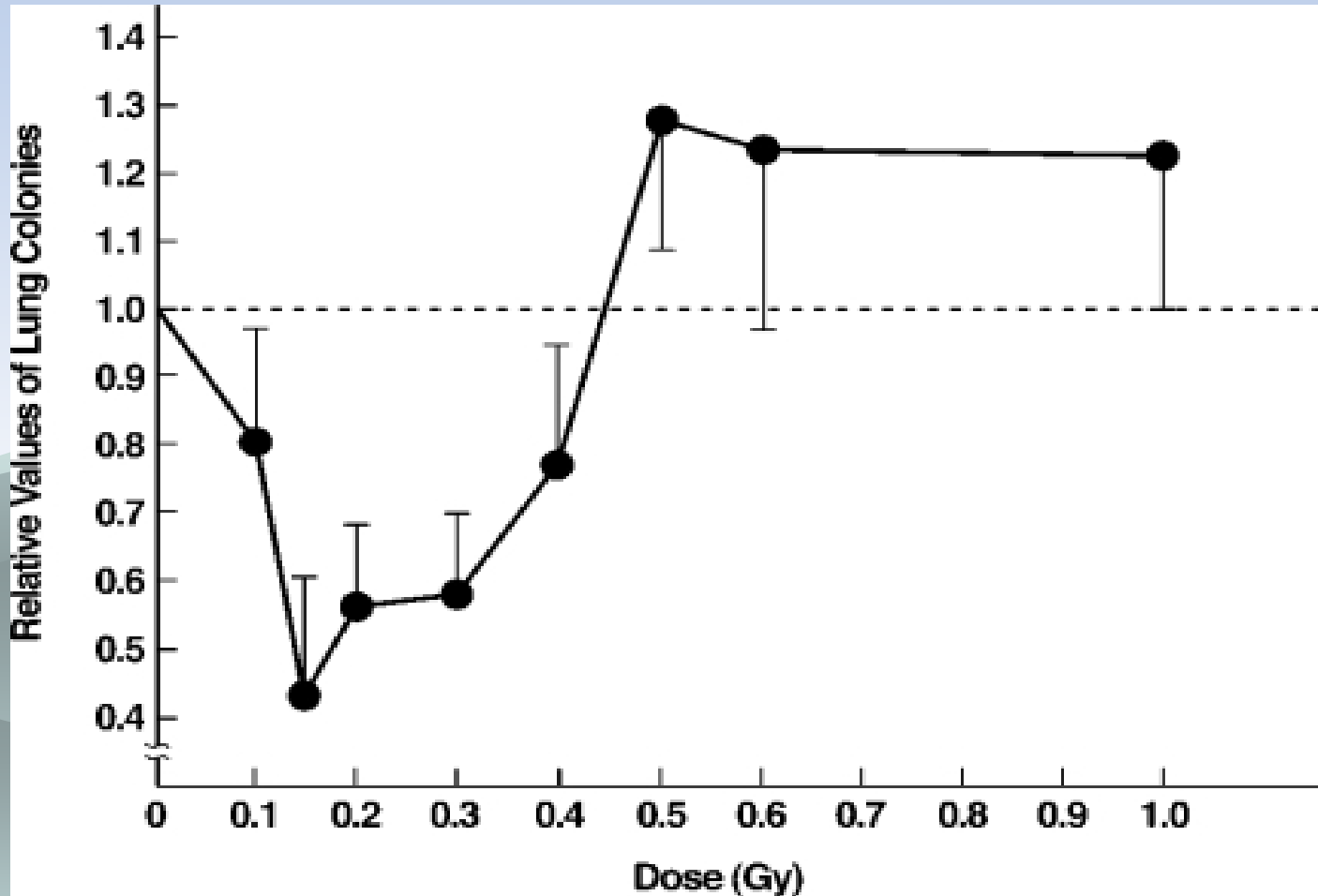
International: Int. Association of Rad. Res., Rad. Res. Society (Councillor)
Am. Society Therapeutic Radiology and Oncology (emeritus)

National: Japan Cancer Association, Japan Radiological Society, J Rad Res,
Japan Society of Therapeutic Radiology and Oncology (emeritus)

My Low-Dose Radiation Research in Japan

- ◆ My fundamental studies on LDR effects on cancer started in 1975 with an experiment to determine the minimum dose required to suppress immunological response.
- ◆ I discovered that irradiation with low doses, 10 to 15 cGy, actually promoted immunological response, which was a complete surprise!
- ◆ This led me to perform a series of experiments, over 12 years, on effects of LDR on cancer, which was funded by the Japanese Federal Government.
- ◆ Clinical studies and LDR treatment to ~200 patients

Results of one of my studies: Spontaneous Lung Metastasis vs. TB Dose



Other Low Dose Rad Research in Japan

- ◆ Three Mile Island Accident occurred just before the International Congress of Radiation Research 1979, which was held in Tokyo. One of the papers presented evidence of the lower incidence of lung cancer and the longer lifespan of people living in some high radiation regions of China, compared to people living in low radiation regions. This started additional Japanese research into low dose radiation health effects.
- ◆ 14 universities and 2 research institutes now carry out LDR research (Hormesis Research Steering Committee)
- ◆ LDR bio-positive effect studies include: cell rejuvenation, cancer treatment/prevention, stress moderation, diabetes, gene repair, p53 stimulation, hypertension, radiation adaptive response, effect of radon on inflammation, immune system stimulation

Clinical Trial for Malignant Lymphoma

- ◆ NHL selected for first clinical trial because it has high likelihood of distant metastasis when the primary tumor is found
- ◆ Effect of radiation therapy on lymphoma can be readily assessed by inspection
- ◆ Mice studies show that TB or HB doses of 10 or 15 cGy prevent distant metastases
- ◆ Enhanced cell killing and suppression of tumor regrowth, when TB low dose radiation is combined with local high dose radiation

Combined Treatment Schedule

- ◆ **Radiation:** 6 MV x-rays

- ◆ **TB or HB LDR:**

 - ❖ 10 cGy fraction, 3/wk, 5 wks = 150 cGy **or**

 - ❖ 15 cGy fraction, 2/wk, 5 wks = 150 cGy

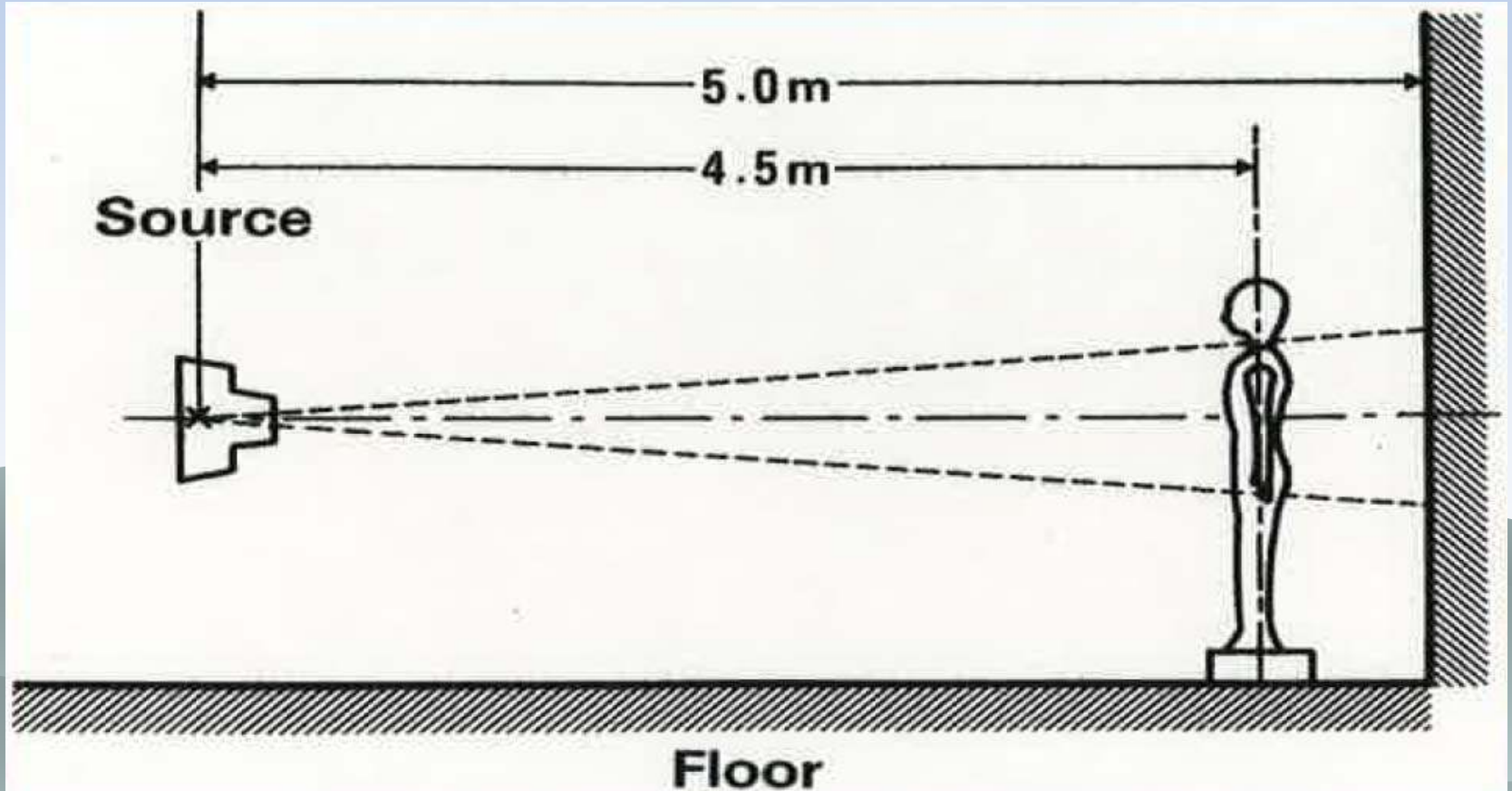
- ◆ **Local HDR schedule 1**

 - ❖ 2 Gy fraction, 5/wk, 6 wks = 60 Gy after 5 wk of LDR treatment has been completed

- ◆ **Local HDR schedule 2**

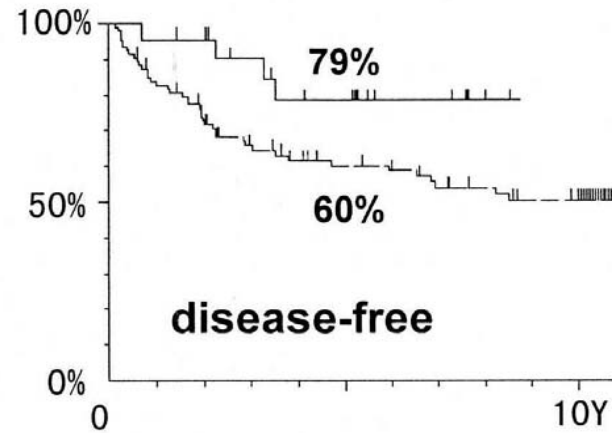
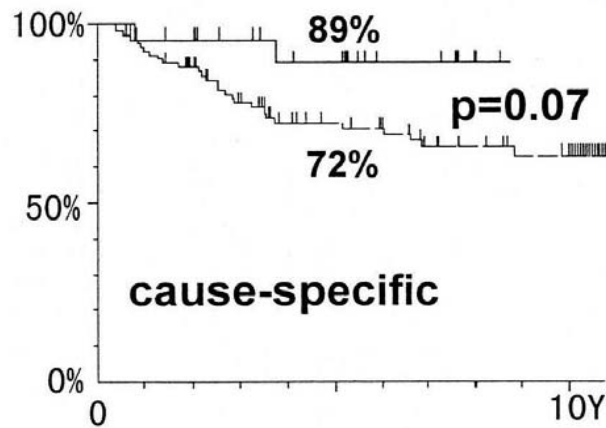
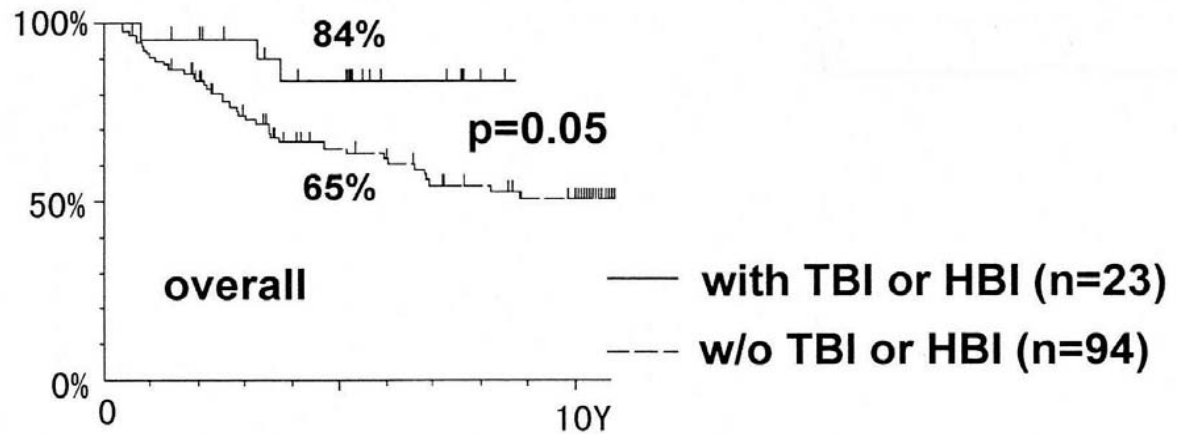
 - ❖ 2 Gy fraction 5/wk, 6 wks, but give HD fraction 6 hr after each LD fraction, during 5 wk course

Source - Patient Schema HB LDR



HBI or TBI for Non-Hodgkin's Lymphoma

Survivals of Stage I,II Non-Hodgkin's Lymphoma



Summary of Biological Research

- 1 TBI or HBI (10 ~ 15 cGy) enhances immunological ability for tumors in mice.
- 2 TBI or HBI increases efficacy of local high dose irradiation, and increases tumor cure rate.
- 3 TBI or HBI prevents distant metastasis.
- 4 The effect obtained by TBI or HBI is observed when irradiation applied only to spleen.

Summary of Clinical Research

- 1 TBI or HBI (1.0 or 1.5 cGy) enhances the immunological ability against tumors.
- 2 TBI or HBI prevents distant metastasis of cancer.
- 3 In malignant lymphoma some cases can only be cured by TBI or HBI therapy.
- 4 TBI or HBI increase the efficacy of local high dose irradiation.
- 5 Combined therapy is more effective in treatment for undifferentiated tumors.

Conclusions

- ◆ Much information is known about the effects of low doses and low levels of radiation on living organisms, especially mice and people
- ◆ Low doses of radiation stimulate:
 - ❖ immunity to cancer
 - ❖ biological defences against DNA damage
- ◆ LDR can be used to cure/prevent cancer
- ◆ The dose or dose rate at which radiation starts to become harmful is also known
- ◆ There is no basis to fear low-level radiation

