

URINARY BLADDER TUMORS AMONG ATOMIC BOMB SURVIVORS  
HIROSHIMA AND NAGASAKI, 1961-72

原爆被爆者における膀胱腫瘍、広島・長崎、1961 - 72 年

HAYATO SANEFUJI, M.D. 実藤隼人

TORANOSUKE ISHIMARU, M.D., M.P.H. 石丸寅之助

in cooperation with

共同研究者

HIROSHI HARA, M.D. 原 弘

HIROMI NIHIRA, M.D. 仁平寛己

NOBUHIKO HIROMOTO, M.D. 広本宣彦

ATSUSHI KONDO, M.D. 近藤 厚

TSUYOSHI TOKUNAGA, M.D. 徳永 剛

HIROSHI FUJII, M.D. 藤井 浩



RADIATION EFFECTS RESEARCH FOUNDATION

財団法人 放射線影響研究所

A cooperative Japan - United States Research Organization

日米共同研究機関

## ACKNOWLEDGMENT

### 謝 辞

The authors are grateful to Dr. Toshio Fujikura, Chief, Department of Pathology, RERF, for his advice on the preparation of the manuscript. They extend their sincere appreciation to Dr. William J. Schull, Vice-Chairman and Acting Chief of Research, RERF, for his help and comments. They also wish to express their thanks to the Tumor Registries in Hiroshima and Nagasaki for providing information on possible cases of urinary bladder tumors in the study cohort over the years.

原稿の作成に当たって助言を頂いた放影研病理部長藤倉敏夫博士に感謝の意を表す。また助言並びに校閲を受けた放影研副理事長兼研究担当理事代理 Dr. William J. Schull に深謝する。また、長年にわたり本調査対象者集団の膀胱腫瘍と思われる症例に関する情報を提供していただいた広島及び長崎の腫瘍登録関係者に謝意を表す。

## RERF TECHNICAL REPORT SERIES

### 放影研業績報告書集

The RERF Technical Reports provide the official bilingual statements required to meet the needs of Japanese and American staff members, consultants, and advisory groups. The Technical Report Series is in no way intended to supplant regular journal publication.

放影研業績報告書は、日米専門職員、顧問、諮問機関の要求に応えるための日英両語による公式報告記録である。業績報告書は決して通例の誌上発表論文に代わるものではない。

---

*The Radiation Effects Research Foundation (formerly ABCC) was established in April 1975 as a private nonprofit Japanese Foundation, supported equally by the Government of Japan through the Ministry of Health and Welfare, and the Government of the United States through the National Academy of Sciences under contract with the Department of Energy.*

放射線影響研究所(元ABCC)は、昭和50年4月1日に公益法人として発足した。その経費は日米両政府の平等分担とし、日本は厚生省の補助金、米国はエネルギー省との契約に基づく米国学士院の補助金をもって充てる。



# URINARY BLADDER TUMORS AMONG ATOMIC BOMB SURVIVORS HIROSHIMA AND NAGASAKI, 1961-72

原爆被爆者における膀胱腫瘍，広島・長崎，1961 - 72 年

HAYATO SANEFUJI, M.D. (実藤隼人)<sup>1</sup>; TORANOSUKE ISHIMARU, M.D., M.P.H. (石丸寅之助)<sup>2</sup>;

in cooperation with  
共同研究者

HIROSHI HARA, M.D. (原弘)<sup>3</sup>; HIROMI NIHIRA, M.D. (仁平寛己)<sup>4</sup>;  
NOBUHIKO HIROMOTO, M.D. (広本宣彦)<sup>4</sup>; ATSUSHI KONDO, M.D. (近藤厚)<sup>5</sup>;  
TSUYOSHI TOKUNAGA, M.D. (徳永剛)<sup>5</sup>; HIROSHI FUJII, M.D. (藤井浩)<sup>6</sup>

*RERF Departments of Pathology<sup>1</sup> and Epidemiology & Statistics<sup>2</sup>; Departments of Pathology<sup>3</sup> and Urology<sup>4</sup>, Hiroshima University School of Medicine; Department of Urology, Nagasaki University School of Medicine<sup>5</sup>; and Department of Urology, Hiroshima Citizens Hospital<sup>6</sup>*

放影研病理部<sup>1</sup>及び疫学統計部<sup>2</sup>; 広島大学医学部病理学教室<sup>3</sup>及び泌尿器科学教室<sup>4</sup>; 長崎大学医学部泌尿器科学教室<sup>5</sup>; 広島市民病院泌尿器科<sup>6</sup>

## SUMMARY

A study was made of the relationship of radiation dose to the incidence of urinary bladder tumors among atomic bomb survivors and controls in the RERF Life Span Study extended sample. A total of 112 cases of urinary bladder tumors was identified among approximately 99,000 subjects in this fixed cohort during 1961-72. Morphologic diagnoses were available for 86 cases (76.8%), cystoscopy alone for 21 cases (18.7%), and only the cause of death recorded on death certificates for 5 cases (4.5%). Urothelial carcinoma (transitional cell carcinoma) is the most common type of urinary bladder tumor for which morphologic diagnoses are available.

The 1961-72 incidence rate was calculated using 106 cases identified as urinary bladder tumors. Although the crude annual incidence rate in the high dose group (100 rad or more) is elevated in both cities and both sexes, all nine cases with this dose were aged 40 years or more at the time of the bomb (ATB). The standardized relative risk adjusted for city and sex for those of age 40 or more ATB in the high dose group is 1.8 in comparison with the control group and this is a suggestive statistical difference. A statistically significant elevation of risk occurs in the high dose group for urothelial carcinoma and adenocarcinoma of the urinary bladder among those aged 40 or more ATB.

## 要約

放影研の寿命調査拡大集団の被爆者と対照者の膀胱腫瘍発生率と被曝線量の関係について調査した。この固定集団に属する約99,000人の対象から1961-72年の間に112名の膀胱腫瘍を確認した。組織型を確認したのは86例(76.8%)であり、膀胱鏡の検査のみにより診断したのは21例(18.7%)で、死亡診断書の死因のみにより診断したのは5例(4.5%)であった。組織型を確認できた膀胱腫瘍の中では尿路上皮癌(移行上皮癌)が最も多かった。

1961-72年の発生率の計算には106名の膀胱腫瘍を用いた。100 rad以上の高線量群における膀胱腫瘍の年間粗発生率は両市及び男女とも上昇していたが、高線量群の9例の全例が被爆時年齢は40歳以上であった。被爆時年齢40歳以上の群の高線量群における都市及び性を標準化した相対的危険率は、対照群に比較し1.8で統計的な有意差が示唆された。被爆時年齢40歳以上では膀胱の尿路上皮癌と腺癌で統計的に有意に高線量群における危険率の上昇を認めた。

## INTRODUCTION

The excess risk of urinary bladder tumors among workers employed in the manufacture of dyes and certain chemical substances who are chronically exposed to particular chemical carcinogens is well known.<sup>1,2</sup> There are few reports, however, relating induction of urinary bladder tumors to ionizing radiation. The 1977 report of the United Nations Scientific Committee on the Effects of Atomic Radiation<sup>3</sup> presented some findings on mortality from cancer of the bladder among patients following the irradiation of the pelvis by radium or X-rays. Beebe et al<sup>4</sup> reported suggestive evidence for possible induction by atomic radiation of malignant neoplasms of the bladder and other urinary organs among proximally exposed A-bomb survivors, based on the pathology diagnosis of the autopsy materials in the RERF Life Span Study (LSS) sample during 1961-65. Recent analyses of deaths among A-bomb survivors in the mortality study sample suggest an increased mortality due to cancer of the urinary organs by radiation dose.<sup>5,6</sup> However, these authors noted that only about 40% of the deaths attributed to these cancers were recorded on the death certificates.<sup>6</sup>

The present analysis reports the relationship between development of urinary bladder tumors and dose for A-bomb survivors and controls in the LSS extended sample during 1961-72.

## MATERIALS AND METHODS

The study subjects were selected from the LSS extended sample,<sup>5</sup> Hiroshima and Nagasaki, who were alive as of 1 January 1961. They numbered 98,663 individuals with 74,355 in Hiroshima and 24,308 in Nagasaki, including 74,114 A-bomb survivors, and 24,549 subjects who were not in the city (NIC) ATB. Exposure dose of the individual A-bomb survivors was calculated by the T65D system.<sup>7</sup> The T65D total dose is the sum of independent estimates of the gamma and neutron doses in rad.

Table 1 shows the distribution of the subjects by dose, city, and sex. Dose is unknown for 2,194 (2.2%) of the total individuals. It appears that subjects are differently distributed by dose and city.

### Ascertainment of Urinary Bladder Tumors

Cases diagnosed as tumors of the urinary system during 1961-72 were screened from the mortality

## 緒言

染料やある種の化学薬品の製造業に従事し、特定の化学発癌物質に慢性的に被曝した従業員の膀胱腫瘍の危険率が高いことはよく知られている。<sup>1,2</sup> しかし、電離放射線被曝と膀胱腫瘍誘発との関係についての報告はほとんどない。国連原子放射線影響科学委員会の1977年報告<sup>3</sup>では、骨盤にラジウムやX線を受けた患者の膀胱癌死亡率に関する所見が幾つか報告されている。Beebeら<sup>4</sup>は1961-65年の放影研寿命調査対象者の剖検例の病理学的診断に基づき、近距離被爆者の膀胱及び他の泌尿器の悪性新生物が原爆放射線によって誘発される可能性を示唆する結果を報告した。寿命調査対象者中の被爆者の死亡に関する最近の解析によれば、放射線量別にみて泌尿器癌の死亡率が上昇していることが示唆されている。<sup>5,6</sup> しかし、これらの著者によれば、この種の癌による死亡のうち、死亡診断書に癌と記録されていたのはわずか約40%であった。<sup>6</sup>

本報では1961-72年の寿命調査拡大集団中の被爆者及び対照者の膀胱腫瘍の発生と線量との関係を検討した。

## 材料及び方法

調査対象者は1961年1月1日現在生存していた広島・長崎の寿命調査拡大集団<sup>5</sup>から抽出した被爆者74,114人、原爆時市内不在者24,549人からなる広島74,355人、長崎24,308人、計98,663人である。各被爆者の被曝線量はT65D推定線量方式<sup>7</sup>によって算出した。T65D総線量はガンマ線と中性子線のそれぞれの推定値の合計をrad単位で示すものである。

表1に線量、都市及び性別対象者分布を示した。全対象者中2,194人(2.2%)については線量が不明である。対象者の線量別並びに都市別分布は異なっているようである。

### 膀胱腫瘍の確認

死亡率調査、<sup>5</sup> 病理学的調査<sup>8</sup>及び広島・長崎腫瘍

TABLE 1 DISTRIBUTION OF INDIVIDUALS IN THE LSS EXTENDED SAMPLE BY CITY, SEX, &amp; DOSE, 1 JANUARY 1961

表 1 寿命調査拡大集団対象者の都市、性及び線量別分布、1961年1月1日

Item		T65 dose in rad					Total
		NIC	<1	1-99	100+	Unk	
Hiroshima	No.	18711	26851	24633	2915	1245	74355
	%	25.2	36.1	33.1	3.9	1.7	100.0
Nagasaki	No.	5838	4285	10666	2570	949	24308
	%	24.0	17.6	43.9	10.6	3.9	100.0
Male	No.	10124	12470	14232	2366	992	40184
	%	25.2	31.0	35.4	5.9	2.5	100.0
Female	No.	14425	18666	21067	3119	1202	58479
	%	24.7	31.9	36.0	5.3	2.1	100.0
Total	No.	24549	31136	35299	5485	2194	98663
	%	24.9	31.5	35.8	5.6	2.2	100.0

study,<sup>5</sup> pathology study<sup>8</sup> and the Hiroshima and Nagasaki Tumor Registries data.<sup>9</sup> In cooperation with urologists of the larger hospitals of Hiroshima and Nagasaki additional efforts were made to ascertain all urinary bladder tumors in this sample unreported to the Tumor Registries in the two cities during 1961-72.

Based on the autopsy and biopsy materials available, the morphologic types of urinary bladder tumors were classified by the pathologist (H.S.). Altogether, 112 cases of urinary bladder tumors were identified in the LSS extended sample, Hiroshima and Nagasaki, between 1961-72. By morphologic type 86 cases were identified including 81 urothelial carcinoma (synonym: transitional cell carcinoma<sup>10</sup>), 3 adenocarcinoma, 1 mixed type of carcinoma, and 1 sarcoma. Twenty-one cases of urinary bladder tumors identified by cystoscopy alone were classified as a papillary tumor of the bladder upon reference to the clinical findings on the medical records. Only five cases were designated as cancer of the urinary bladder by the cause of death given on the death certificate and these were classified as carcinoma of the bladder, type unknown.

#### Calculation of Incidence Rate and Statistical Evaluation

The annual incidence rates of urinary bladder tumors in the LSS extended sample are expressed in terms of person-years at risk to examine the

登録の資料<sup>9</sup>を用いて、1961-72年に泌尿器系腫瘍と診断された症例のスクリーニングを行った。更に広島・長崎の主要病院の泌尿器科専門医と協力して、対象者の中で1961-72年に両市の腫瘍登録に報告されなかったすべての膀胱腫瘍例を確認するよう努力した。

入手した剖検及び生検材料を基に病理学専門医(H.S.)が泌尿器腫瘍の組織型の分類を行った。広島・長崎の寿命調査拡大集団で1961-72年に総計112例の膀胱腫瘍が確認された。組織型別にみて、尿路上皮癌(移行上皮癌<sup>10</sup>)81例、腺癌3例、混合型1例、肉腫1例、計86例が確認された。膀胱鏡検査のみで確認した膀胱腫瘍21例は、医学記録の臨床所見を参照して膀胱乳頭状腫瘍として分類した。死亡診断書の死因のみで膀胱癌と診断されたのはわずか5例で、これらは型不明の膀胱癌として分類した。

#### 発生率の計算及び統計学的評価

線量効果を都市、性、被爆時年齢及び組織型別に調べるために寿命調査拡大集団の膀胱腫瘍の年間

TABLE 2 DISTRIBUTION OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE BY MORPHOLOGIC TYPE, SEX, &amp; AGE AT DIAGNOSIS, HIROSHIMA AND NAGASAKI 1961-72

表2 寿命調査拡大集団における膀胱腫瘍の分布；組織型，性，診断時年齢別，広島及び長崎，1961-72年

Morphologic type		Total	Sex		Age at diagnosis			
			M	F	<40	40-59	60-69	70+
Urothelial cancer	No.	81	53	28	3	9	26	43
	%	72.3	76.8	65.1	75.0	64.3	66.7	78.2
Adenocarcinoma	No.	3	1	2	0	0	1	2
	%	2.7	1.5	4.7	0	0	2.6	3.6
Mixed type	No.	1	1	0	0	0	1	0
	%	0.9	1.5	0	0	0	2.6	0
Sarcoma	No.	1	0	1	1	0	0	0
	%	0.9	0	2.3	25.0	0	0	0
Papillary tumor	No.	21	12	9	0	4	9	8
	%	18.7	17.3	20.9	0	28.6	23.0	14.6
Type unknown	No.	5	2	3	0	1	2	2
	%	4.5	2.9	7.0	0	7.1	5.1	3.6
Total	No.	112	69	43	4	14	39	55
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0

dose effect by city, sex, age ATB, and morphologic type.<sup>11,12</sup> The standardized relative risk and the statistical differences were examined by the procedure of Mantel and Haenszel<sup>13</sup> using the risks based on the number of study subjects.

## RESULTS

### Distribution of Urinary Bladder Tumors by Morphologic Type, Sex, and Age

Table 2 shows the distribution of the 112 cases of urinary bladder tumors identified in this study by morphologic type, sex, and age at diagnosis. Urothelial carcinoma was the most frequent type with 72.3%; adenocarcinoma 2.7%; mixed type of carcinoma 0.9%; sarcoma 0.9%; papillary tumors of the bladder 18.7%; and carcinoma of the bladder, type unknown 4.5%. Urothelial carcinoma was the most frequent type of tumor in both sexes and every age category. Of the 112 cases 94 (83.9%) were aged 60 years or more at the diagnosis of the disease.

### Incidence Rate of Urinary Bladder Tumors in LSS Extended Sample During 1961-72

Of the 112 urinary bladder tumors, 6 were excluded from the calculation of incidence rates because they were diagnosed prior to 1 January 1961.

発生率を観察人年で表した。<sup>11,12</sup> 調査対象者数に基づく危険率を用いて Mantel 及び Haenszel 法<sup>13</sup>で標準化相対的危険率及び統計的有意差を調べた。

## 結 果

### 膀胱腫瘍の組織型、性及び年齢別分布

表2に本調査で確認された112例の膀胱腫瘍の組織型、性及び診断時年齢別分布を示した。最も多かったのは尿路上皮癌で72.3%であり、腺癌2.7%、混合型0.9%、肉腫0.9%、乳頭状膀胱腫瘍18.7%、型不明の膀胱癌4.5%であった。尿路上皮癌は男女とも、すべての年齢区分で最も多かった。112例中94例(83.9%)が診断時年齢60歳以上であった。

### 寿命調査拡大集団における1961-72年の膀胱腫瘍発生率

膀胱腫瘍112例中6例は1961年1月1日以前に診断されたため、発生率の計算から除外した。

TABLE 3 CRUDE ANNUAL INCIDENCE RATE OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE BY DOSE &amp; MORPHOLOGIC TYPE, 1961-72

表3 寿命調査拡大集団における膀胱腫瘍の年間粗発生率；線量及び組織型別，1961—72年

Item	T65 dose in rad				Total
	NIC & <1	1-99	100+	Unk	
Person years	626164	394719	61726	25055	1107664
Morphologic type (Annual incidence rate per 100,000 population)					
Urothelial carcinoma	7.5 (47)	4.8 (19)	11.3 (7)	12.0 (3)	6.9 (76)
Adenocarcinoma	0.2 (1)	0.3 (1)	1.6 (1)	0.0 (0)	0.3 (3)
Mixed type of carcinoma	0.0 (0)	0.3 (1)	0.0 (0)	0.0 (0)	0.1 (1)
Sarcoma	0.2 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.1 (1)
Papillary tumor	1.6 (10)	2.3 (9)	1.6 (1)	0.0 (0)	1.8 (20)
Type unknown	0.6 (4)	0.3 (1)	0.0 (0)	0.0 (0)	0.5 (5)
Total	10.1 (63)	7.9 (31)	14.6 (9)	12.0 (3)	9.6 (106)
90% confidence limits for total bladder tumors					
Upper	12.4	10.6	25.4	30.9	11.2
Lower	8.1	5.7	7.6	3.3	8.1
Crude relative risk	1.0	0.8	1.4	1.2	-

6 cases (5 urothelial carcinomas and 1 papillary tumor) with onset before 1961 were excluded in the calculation of the incidence rate.

Number of cases in parentheses.

1961年以前に発現した6例（尿路上皮癌5例，乳頭状腫瘍1例）は発生率計算から除外した。

括弧内は症例数。

Table 3 presents the crude annual incidence rates of urinary bladder tumors per 100,000 population in the LSS extended sample during 1961-72 by dose and morphologic type. The crude incidence rate for all types of urinary bladder tumors is 1.4 times higher in the high dose group (100 rad or more) than in the control group (<1 rad and NIC); however, this difference is not statistically significant. Although the numbers are small when examined by morphologic type and dose, the increased risk in the high dose group seems restricted to urothelial carcinoma and adenocarcinoma of the urinary bladder. Table 4 shows the crude annual incidence rates of urinary bladder tumors by dose and city. The crude relative risk for the high dose group is 1.5 in Hiroshima and 1.6 in Nagasaki. Again, these rates are not statistically significant. Table 5 shows the crude annual incidence rate for urinary bladder tumors by dose and sex. The crude relative risk in the high dose group is 1.3 in males and 1.6 in females with no significant difference.

Table 6 shows the crude annual incidence rates of urinary bladder tumors by dose and three age

表3に寿命調査拡大集団における1961—72年の人口10万人当たりの膀胱腫瘍の年間粗発生率を線量及び組織型別に示した。すべての組織型の膀胱腫瘍の粗発生率は高線量群（100 rad以上）が対照群（1 rad未満及び市内不在者）の1.4倍であるが、この差は統計的に有意ではない。組織型及び線量別にみると症例数は少ないが、高線量群の危険率増加は尿路上皮癌及び腺癌に限られているように思われる。表4に膀胱腫瘍の年間粗発生率を線量及び都市別に示した。高線量群の粗相対的危険率は広島1.5、長崎1.6である。これらの危険率も統計的に有意でない。表5に膀胱腫瘍の年間粗発生率を線量及び性別に示した。高線量群の粗相対的危険率は男性1.3、女性1.6で、統計的有意差はない。

表6に膀胱腫瘍の年間粗発生率を線量及び三つの被爆時年齢区別に示した。高線量群の9例は、



TABLE 4 CRUDE ANNUAL INCIDENCE RATE OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE BY DOSE &amp; CITY, 1961-72

表4 寿命調査拡大集団における膀胱腫瘍の年間粗発生率；線量及び都市別，1961—72年

Item	T65 dose in rad				Total	
	NIC & <1	1-99	100+	Unk		
Hiroshima						
Person years	511319	274601	32410	14222	832552	
Cases	53	16	5	2	76	
Rate (10 <sup>-5</sup> )	10.4	5.8	15.4	14.0	9.1	
90% confidence limits	Upper	13.0	8.8	32.4	44.3	10.9
	Lower	8.2	3.7	6.1	2.5	7.6
Crude relative risk	1.0	0.6	1.5	1.3	-	
Nagasaki						
Person years	114845	120118	29316	10833	275112	
Cases	10	15	4	1	30	
Rate (10 <sup>-5</sup> )	8.7	12.4	13.6	9.2	10.9	
90% confidence limits	Upper	14.8	19.2	31.2	43.8	14.8
	Lower	4.7	7.7	4.7	0.5	7.9
Crude relative risk	1.0	1.4	1.6	1.1	-	

See note Table 3.

ATB categories. All nine cases in the high dose group were in individuals aged 40 or more ATB. The crude relative risk in the high dose group is 2.0; compared with the low dose group this is not a statistically significant difference. No urinary bladder tumors occurred in the high dose group among persons under age 40 ATB during the period from 15 to 27 years after exposure.

Table 7 shows the crude annual incidence rates of urinary bladder tumors by dose and morphologic type for those aged 40 or more ATB. It appears that an excess risk of urothelial carcinoma and adenocarcinoma exists in the high dose group.

Table 8 shows the standardized relative risk adjusted for sex and city among those aged 40 or more ATB for all types of urinary bladder tumors, and urothelial carcinoma and adenocarcinoma by dose. The standardized relative risk for all types of urinary bladder tumors in the high dose group compared with the control group is about 1.8; the risk in the low dose group (1-99 rad) is about 0.7. Examined by the procedure of Mantel and Haenszel<sup>13</sup> the difference is suggestive ( $.05 < P \leq .10$ ). For a similar comparison of the risk of urothelial

すべて被爆時年齢40歳以上であった。高線量群の粗相対的危険率は2.0で、低線量群と比較して統計的有意差はない。被爆後15年から27年までの期間には、高線量群で被爆時年齢が40歳未満の者に膀胱腫瘍は発現しなかった。

表7に被爆時年齢40歳以上の者の膀胱腫瘍の年間粗発生率を線量及び組織型別に示した。高線量群では尿路上皮癌及び腺癌の危険率増加が見られるようである。

表8に被爆時年齢40歳以上の者のすべての型の膀胱腫瘍と尿路上皮癌及び腺癌について、性及び都市を標準化した相対的危険率を線量別に示した。対照群と比較した高線量群のすべての型の膀胱腫瘍の標準化相対的危険率は約1.8で、低線量群(1-99 rad)では約0.7である。Mantel及びHaenszel法<sup>13</sup>を用いて調べると、有意差が示唆された( $.05 < P \leq .10$ )。尿路上皮癌及び腺癌の線量別危険率を同様に比較



TABLE 5 CRUDE ANNUAL INCIDENCE RATE OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE BY DOSE &amp; SEX, 1961-72

表5 寿命調査拡大集団における膀胱腫瘍の年間粗発生率；線量及び性別，1961—72年

Item	T65 dose in rad				Total
	NIC & <1	1-99	100+	Unk	
Male					
Person years	249658	156075	26036	11056	442825
Cases	36	23	5	3	67
Rate (10 <sup>-5</sup> )	14.4	14.7	19.2	27.1	15.1
90% confidence limits	Upper	19.0	20.9	40.3	70.1
	Lower	10.7	10.1	7.6	7.4
Crude relative risk	1.0	1.0	1.3	1.9	-
Female					
Person years	376506	238644	35690	13999	664839
Cases	27	8	4	0	39
Rate (10 <sup>-5</sup> )	7.1	3.3	11.2	0.0	5.8
90% confidence limits	Upper	9.9	6.1	25.6	-
	Lower	5.1	1.7	3.8	-
Crude relative risk	1.0	0.5	1.6	-	-

See note Table 3.

TABLE 6 CRUDE ANNUAL INCIDENCE RATE OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE BY DOSE &amp; AGE ATB, 1961-72

表6 寿命調査拡大集団における膀胱腫瘍の年間粗発生率；線量及び被爆時年齢別，1961—72年

Item	T65 dose in rad				Total
	NIC & <1	1-99	100+	Unk	
Age <20 ATB					
Person years	289787	187175	30116	12959	520037
Cases	2	1	0	0	3
Rate (10 <sup>-5</sup> )	0.7	0.5	0.0	0.0	0.6
90% confidence limits	Upper	2.2	2.5	-	1.5
	Lower	0.1	0.0	-	0.2
Crude relative risk	1.0	0.8	-	-	-
Age 20-39 ATB					
Person years	195219	118180	19672	8200	341271
Cases	9	4	0	1	14
Rate (10 <sup>-5</sup> )	4.6	3.3	0.0	12.2	4.1
90% confidence limits	Upper	8.0	7.7	57.9	6.4
	Lower	2.4	1.2	0.6	2.5
Crude relative risk	1.0	0.7	-	2.7	-
Age 40+ ATB					
Person years	141158	89364	11938	3896	246356
Cases	52	26	9	2	89
Rate (10 <sup>-5</sup> )	36.8	29.1	75.4	51.3	36.1
90% confidence limits	Upper	46.3	40.4	161.7	43.0
	Lower	28.9	20.4	39.3	30.1
Crude relative risk	1.0	0.8	2.0	1.4	-

See note Table 3.

TABLE 7 CRUDE ANNUAL INCIDENCE RATE OF URINARY BLADDER TUMORS  
IN THE LSS EXTENDED SAMPLE WHOSE AGE ATB WAS 40 OR MORE  
BY DOSE & MORPHOLOGIC TYPE, 1961-72

表7 被爆時年齢40歳以上の寿命調査拡大集団対象者の膀胱腫瘍年間  
粗発生率；線量及び組織型別，1961-72年

Item	T65 dose in rad		
	NIC & <1	1-99	100+
Person years	141158	89364	11938
Morphologic type (Crude annual incidence rate per 100000 population)			
Urothelial carcinoma	29.0 (41)	16.8 (15)	58.6 (7)
Adenocarcinoma	0.7 (1)	1.1 (1)	8.4 (1)
Mixed type	0.0 (0)	1.1 (1)	0.0 (0)
Papillary tumor	5.0 (7)	9.0 (8)	8.4 (1)
Type unknown	2.1 (3)	1.1 (1)	0.0 (0)

See note Table 3.

TABLE 8 COMPARISON OF STANDARDIZED RELATIVE RISK FOR URINARY  
BLADDER TUMOR IN THE LSS EXTENDED SAMPLE WHOSE AGE WAS 40  
OR MORE ATB, 1961-72

表8 被爆時年齢40歳以上の寿命調査拡大集団対象者の膀胱腫瘍標準化  
相対的危険率の比較，1961-72年

Items	T65 dose in rad		
	NIC & <1	1-99	100+
Subjects	14541	9361	1242
Urinary bladder tumors	52	26	9
Crude incidence rate (/1000)	3.6	2.8	7.2
Standardized relative risk adjusted for city & sex	1.0	0.7	1.8
Statistical test by Mantel & Haenszel's procedure	$\chi^2 = 5.33$	df = 2	.05 < P < .10
Urothelial carcinoma & adenocarcinoma	42	16	8
Crude incidence rate (/1000)	2.9	1.7	6.4
Standardized relative risk adjusted for city & sex	1.0	0.6	1.9
Statistical test by Mantel & Haenszel's procedure	$\chi^2 = 9.58$	df = 2	P < .01

See note Table 3.

carcinoma and adenocarcinoma by dose the difference is significant ( $P < .01$ ). Therefore, it is concluded that the risk of urinary bladder tumors is significantly different by dose and the excess risk in the older age ATB group stems from urothelial carcinoma and adenocarcinoma.

The average period between exposure and diagnosis for the 10 cases of urinary bladder

すると、差は有意である ( $P < .01$ )。したがって、線量別にみた膀胱腫瘍危険率の差は有意であり、被爆時年齢が高齢の群の危険率増加は尿路上皮癌及び腺癌によるものと結論付けられる。

高線量群で被爆時年齢が40歳以上の者の膀胱腫瘍

TABLE 9 AVERAGE PERIOD BETWEEN EXPOSURE AND ONSET  
FOR 10 URINARY BLADDER CASES IN THE LSS EXTENDED  
SAMPLE WHO RECEIVED 100 RAD OR MORE, 1961-72

表9 寿命調査拡大集団における100 rad以上被曝の膀胱腫瘍  
10例の被曝から発病までの平均期間, 1961-72年

Age ATB	Cases	Average period between exposure and diagnosis
40-49	4	25.2 (years)
50-59	4	20.9
60+	2*	18.0
Total	10	21.0

\*1 case diagnosed in 1958 is included. 1958年に診断された1例を含む。

tumors in the high dose group aged 40 or more ATB is shown in Table 9. The numbers are small when divided by three age ATB groups; however, the latency of radiation-induced urinary bladder tumors appears to be shorter with increasing age ATB.

Appendix 1 lists the 112 cases of urinary bladder tumors in the present study.

## DISCUSSION

Reports on radiation-induction of malignant neoplasms of the urinary tract in man are few. Palmer and Spratt<sup>14</sup> reported an excess of bladder cancers following irradiation of the pelvis by therapeutic radiation; the mean latency was 14.0 years. Smith and Doll<sup>15</sup> reported that an excess risk of malignant tumors following bladder pelvic irradiation for metropathia haemorrhagica was improbable. McIntyre and Pointon<sup>16</sup> reported a suggestion of sensitivity of the bladder to cancer-induction by radiation at extremely high doses based on 8,950 patients treated for cancer of the cervix. Mortality data on the A-bomb survivors during 1950-74 suggested an association between mortality from urinary tract cancer and dose among those aged 35 or more ATB.<sup>5</sup>

It is generally said that the histologic classification of carcinoma of the bladder is to some extent unsatisfactory in terms of prognosis.<sup>10</sup> Both benign and malignant neoplasms of urinary bladder are generally classified clinically as tumors of the urinary bladder.<sup>17</sup> The present report includes as papillary tumors of the bladder cases diagnosed as urinary bladder tumors on cystoscopy alone. The diagnosis of papillary

10例の被曝から診断までの平均期間を表9に示した。被曝時年齢群を三つに分けると症例数は少なくなるが、放射線誘発膀胱腫瘍の潜伏期間は被曝時年齢が高くなるに従って短くなるようである。

付録1に本調査の膀胱腫瘍112例を列記した。

## 考 察

人間の泌尿器に対する放射線の悪性新生物誘発効果に関する報告は少ない。Palmer及びSpratt<sup>14</sup>は骨盤に治療用放射線を受けた者に膀胱癌の増加が見られ、その平均潜伏期間は14.0年であったと報告した。Smith及びDoll<sup>15</sup>は本態性子宮出血症のために膀胱骨盤部に放射線を受けた者の悪性腫瘍の危険率増加はあり得ないであろうと報告した。McIntyre及びPointon<sup>16</sup>は子宮頸部癌に対して極めて高い線量で治療を受けた患者8,950人において、膀胱は放射線誘発癌に対して感受性があることが示唆されると報告した。1950-74年の被爆者の死亡率資料は被曝時年齢35歳以上の者の泌尿器癌と線量との関係を示唆している。<sup>5</sup>

一般的に膀胱癌の組織学的分類は予後に関してはある程度不十分なものとされている。<sup>10</sup> 膀胱の良性、悪性新生物は、共に通常臨床的に膀胱腫瘍として分類する。<sup>17</sup> 本報では膀胱鏡検査のみで膀胱腫瘍と診断された症例は膀胱乳頭状腫瘍として含めた。泌尿器科専門医の決定による膀胱乳頭状腫瘍の診断は

tumors of the bladder has very high reliability having been determined by a urologist.

Based on crude annual incidence rate the present analysis of urinary bladder tumors among A-bomb survivors and controls in 1961-72 shows a greater risk in the high dose group than in the control group in both cities and both sexes. No cases of urinary bladder tumor were identified in the 4,242 A-bomb survivors who received 100 rad or more and were under age 40 years ATB, although 16 cases of urinary bladder tumors were identified among the low dose and control group of 67,077 subjects who were under age 40 ATB. Of the 112 persons with urinary bladder tumors in this study 84% developed the disease at 60 years of age or more. Subjects under age 40 ATB were under 55 years in 1961 and less than 67 in 1972. Thus, it appears that most of the study subjects under age 40 ATB had not reached the susceptible age for development of urinary bladder tumors during 1961-72. In contrast to young survivors under age 40 ATB, the standardized relative risk adjusted for city and sex in the high dose group aged 40 or more suggested an effect of radiation. These subjects were aged 55 or more in 1961 and 67 years or more in 1972. Therefore, almost all subjects aged 40 or more ATB reached the susceptible age for development of urinary bladder tumors during the observation period in the present analysis of data. This suggests that the susceptible age for development of urinary bladder tumors and years after exposure have important roles in the detection of radiation-induced urinary bladder tumors.

The latency period of radiation-induced cancer is an interesting subject in considering follow-up data of the risk of malignant neoplasms by site among A-bomb survivors in relation to dose. An epidemiologic difference has already been reported in the development of radiation-induced cancer including leukemia among A-bomb survivors by site of cancer, morphologic type, years after exposure, and quality and quantity of radiation dose.<sup>5,18-21</sup> However, several previous mortality reports<sup>5,22,23</sup> on the RERF fixed cohort suggest it is unlikely that an excess risk of radiation-induced cancer, excluding leukemia and lung cancer occurred before 1961 even among those aged 40 or more ATB. Beebe et al<sup>5</sup> reported that the probable onset of excess mortality for cancer of the urinary organs in the 100 or more rad group would be in 1967-70,

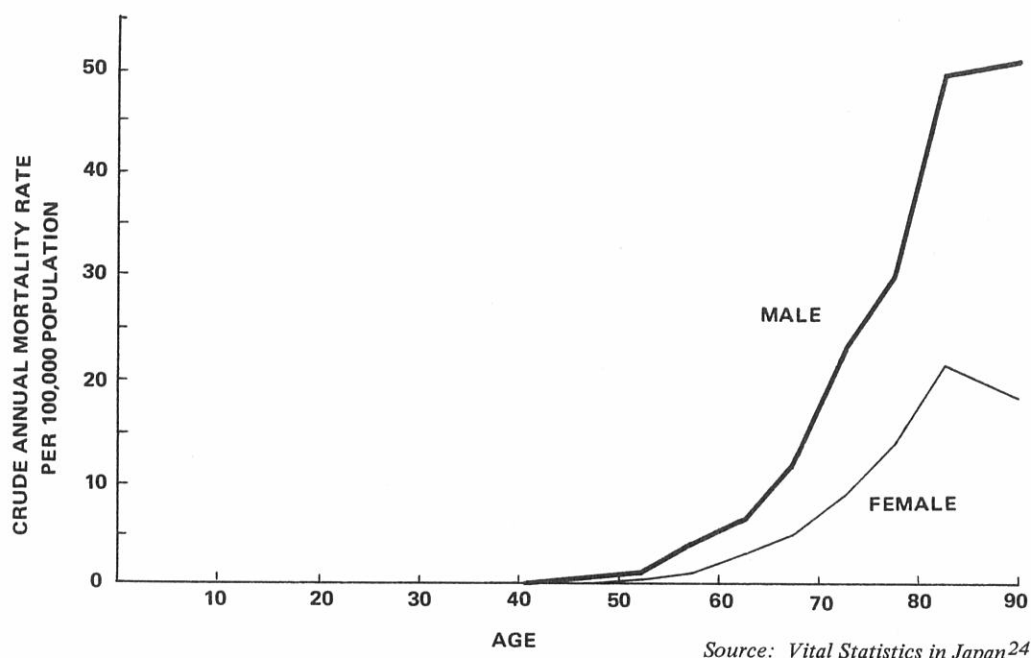
信頼性が非常に高い。

年間粗発生率に基づく1961-72年の被爆者と対照者の膀胱腫瘍の本解析では両市、男女とも対照群より高線量群の方が危険率が高い。被爆時年齢40歳未満の低線量群及び対照群67,077人中に16例の膀胱腫瘍が確認されたが、100 rad以上の放射線を受けた被爆時年齢40歳未満の被爆者4,242人中に膀胱腫瘍例は確認されなかった。本調査で膀胱腫瘍を有していた112人中84%が60歳以上であった。被爆時年齢40歳未満の対象者は、1961年には55歳未満で1972年には67歳未満であった。したがって、被爆時年齢40歳未満の調査対象者のほとんどが1961-72年には膀胱腫瘍の好発年齢に達していないようである。被爆時年齢40歳未満の若年被爆者と対照的に、40歳以上の高線量群の都市及び性を標準化した相対的危険率は放射線の影響を示唆した。これらの対象者は1961年には55歳以上で、1972年には67歳以上であった。したがって、被爆時年齢40歳以上の対象者のほぼ全員が本資料の解析をした観察期間中に膀胱腫瘍の好発年齢に達していた。これは放射線誘発膀胱腫瘍の探知に膀胱腫瘍の好発年齢と被爆後の年数が重要な役割を果たすことを示唆している。

被爆者の部位別悪性新生物の危険率の追跡資料と線量との関係を考える上で、放射線誘発癌の潜伏期間に興味ある課題である。被爆者の白血病を含む放射線誘発癌の発現は、部位、組織型、被爆後年数、放射線質及び線量別にみて疫学的差異があることが既に報告されている。<sup>5, 18-21</sup>しかし、放影研固定集団に関する幾つかの死亡率報告は、<sup>5, 22, 23</sup> 1961年以前に発現した白血病と肺癌を除く放射線誘発癌の危険率増加は、被爆時年齢40歳以上の者においてもみられないであろうということを示唆している。Beebeら<sup>5</sup>は100 rad以上の群の泌尿器癌の死亡率増加の開始と思われる時期は1967-70年、すなわち被爆後22-

FIGURE 1 CRUDE ANNUAL MORTALITY RATE PER 100,000 POPULATION OF CANCER OF BLADDER IN JAPAN BY SEX & AGE, 1975

図1 日本の膀胱癌の性及び年齢別年間粗死亡率(人口10万人当たり), 1975年



or 22-25 years after exposure. The present data have unavoidable limitations for studying the latency period of radiation-induced urinary bladder tumors in relation to age ATB. The observations are restricted to 15 to 27 years after exposure. Therefore, the follow-up of incidence of the disease among exposed survivors for the whole life span is incomplete, especially, in the younger age ATB groups. According to the 1975 Vital Statistics in Japan,<sup>24</sup> the mortality rate for cancer of the urinary bladder increases with age as shown in Figure 1. Urinary bladder tumors are rare in those under 60 years old.

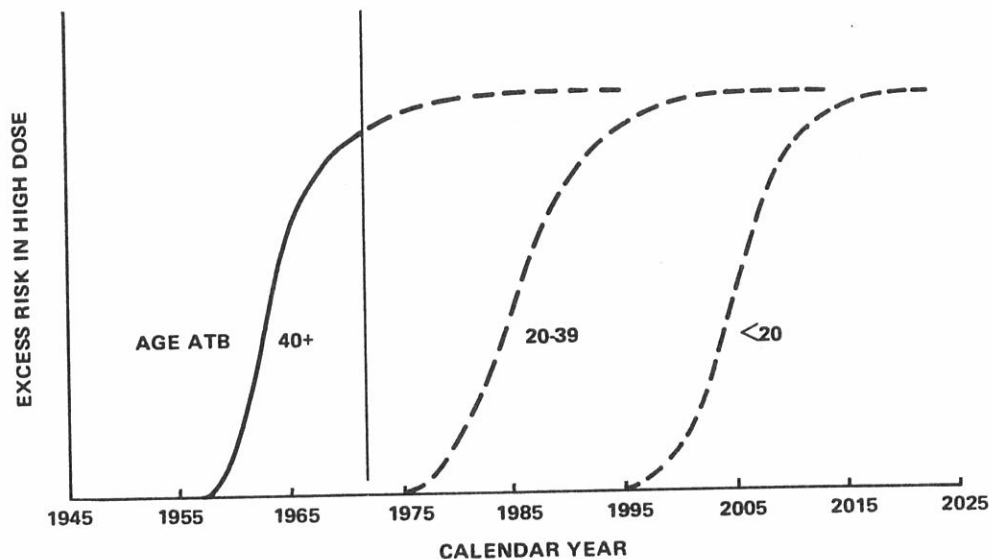
Regarding the present observed evidence, the pattern of excess risk of radiation-induced urinary bladder tumors might be demonstrated in relation to age ATB and calendar year after exposure as shown schematically in Figure 2. It is unlikely that radiation-induced urinary bladder tumors appear only among older age ATB survivors, despite our present inability to demonstrate an increased risk in the younger age ATB group with high dose. This proposed hypothesis concerning the pattern of latency of radiation-induced urinary bladder tumors in

25年であろうと報告した。本資料は放射線誘発膀胱腫瘍の潜伏期間と被爆時年齢の関係を調べる上でさけがたい制約がある。観察期間は被爆後15年から27年までに限定されている。したがって、被爆者の疾患発生率の全生涯にわたる追跡調査は、特に被爆時年齢が若年の群においては完了していない。図1に示したとおり1975年の日本人口動態統計<sup>24</sup>による膀胱癌の死亡率は年齢と共に上昇する。膀胱腫瘍は60歳未満の者には少ない。

本観察資料に関して、放射線誘発膀胱腫瘍の危険率増加と被爆時年齢及び被爆後の暦年数との関係のパターンを図2の図式で表すことができる。本調査では高線量を受けた被爆時年齢が若年の群に危険率の上昇を認めることはできないが、放射線誘発膀胱腫瘍が被爆時年齢が高齢の者にのみ見られるとは思われない。放射線誘発膀胱腫瘍の潜伏期間と被爆時年齢及び被爆後年数との関係のパターンに関する仮

FIGURE 2 SCHEMATIC MODEL FOR EXCESS RISK (CUMULATIVE RISK) OF RADIATION-INDUCED URINARY BLADDER TUMORS IN RELATION TO AGE ATB & YEARS AFTER EXPOSURE

図2 放射線誘発膀胱腫瘍の危険率増加(累積危険率)と被爆時年齢及び被爆後年数との関係の図式モデル



relation to age ATB and years after exposure must await further observations on the A-bomb survivors for support or disproof.

Examined by dose and morphologic type, the significant excess risk in the high dose group aged 40 or more ATB appears to stem from urothelial carcinoma and adenocarcinoma. It is not apparent that papillary tumors of the urinary bladder are related to radiation.

The cases identified in this study were ascertained by retrospective review of medical records and available pathologic materials during 1974-75. Therefore, it was not possible to examine the clinical course and pathologic characteristics of all identified cases in relation to dose.

There were 79 deaths among the 112 cases of urinary bladder tumors reported here during 1961-72. The underlying causes of death on the death certificates were: cancer of the urinary bladder (8th ICD188) 20 (25.3%), cancer of other and unspecified urinary organs (8th ICD189) 17 (21.5%), and neoplasms of unspecified nature of other genitourinary organs

定には、関係を裏付けるものにせよ否定するものにせよ更に被爆者の観察を行わねばならない。

線量及び組織型別にみると、被爆時年齢40歳以上の高線量群の有意な危険率増加は、尿路上皮癌と腺癌によるもののようである。膀胱乳頭状腫瘍と放射線との関係は明らかでない。

本調査で確認された症例は1974-75年に医学記録と入手された病理標本の適切的検討によって確定した。したがって全症例の臨床経過及び病理学的特徴と線量との関係を調べるのは不可能であった。

本報で報告した1961-72年の膀胱腫瘍112例中死亡は79例であった。死亡診断書の原死因は膀胱癌(第8回改正 ICD 188)が20例(25.3%)、他の詳細不明の泌尿器癌(第8回改正 ICD 189)が17例(21.5%)、その他の泌尿器の性質不詳の新生物(第8回 ICD 237)が

(8th ICD237) 10 (12.7%). Death in the other 32 cases was attributed to causes other than neoplasms of the urinary tract. Thus, it appears that a mortality study of urinary bladder tumors based on death certificates is of quite limited value in assessing the radiation effect.

In addition to the study of urinary bladder tumors an attempt was made to detect kidney tumors in the LSS sample in 1961-72. ABCC-JNIH Pathology Studies Report 3<sup>25</sup> of the autopsy program compared the underlying causes of death on death certificates with the principal autopsy diagnoses during 1951-70. The confirmation rate for cancer of the kidney was 27.3% and the detection rate was 23.1%. Therefore, a complete ascertainment of malignant neoplasms of the kidney is not possible without autopsy. From the 4,348 autopsy subjects in the original LSS sample during 1961-72, 32 cases of renal cell carcinoma were identified as malignant neoplasms of the kidney, and there were only 3 such carcinomas among individuals who received 100 rad or more. Two of these three cases were under age 50 years at death, but no renal cell carcinoma of the kidney was identified among those who received less than 100 rad and who were under age 50 at death. The effect of radiation on the risk of malignant neoplasms of the kidneys could not be studied using the RERF autopsy materials during 1961-72, because of the few cases and the biases in the autopsy series in relation to dose, cause of death, age at death, etc.<sup>25,26</sup>

10例(12.7%)であった。他の32例の死亡は泌尿器の新生物以外の原因によるものであった。このように、死亡診断書に基づく膀胱腫瘍の死亡率調査は放射線影響を評価する上で価値が非常に限られている。

膀胱腫瘍の調査に加えて寿命調査対象者における1961-72年の腎臓腫瘍探知の試みがなされた。剖検プログラムに関するABCC一予研調査報告第3報<sup>25</sup>では、死亡診断書の原死因と1951-70年の主な剖検診断を比較した。腎臓癌の確認率は27.3%、発見率は23.1%であった。したがって、腎臓の悪性新生物の完全な確認は剖検なしには不可能である。寿命調査対象者中の1961-72年の剖検対象者4,348人中腎細胞癌32例が腎臓の悪性新生物であることが確認された。100 rad以上に被曝した者ではこの種の癌はわずか3例であった。これら3例中2例が死亡時年齢50歳未満であったが、100 rad未満に被曝した死亡時年齢50歳未満の者には腎臓細胞癌は見られなかった。放射線が腎臓の悪性新生物に与える影響は、剖検調査では症例数が少なく、剖検例には線量、死因、死亡時年齢と関連した偏りがあるため、<sup>25, 26</sup> 1961-72年の放影研剖検材料を用いて線量の効果を調べることはできなかった。



## REFERENCES

## 参考文献

1. ROBERT EE : 職業癌. 原島 進校閲, 土屋健三郎訳. 東京, 日本加除出版株式会社, 1967年  
(ROBERT EE: Occupational Cancer. Ed by S. Harashima, transl by K. Tsuchiya. Tokyo, Nippon Kajyo Shuppan KK, 1967)
2. COWDRY EV: Etiology and Prevention of Cancer in Man. New York, Appleton-Century-Crofts, Division of Meredith Corporation, 1968
3. United Nations Scientific Committee on the Effects of Atomic Radiation. 1977 Report to the General Assembly with Annexes. Sources and Effects of Ionizing Radiation. New York, United Nations, 1977
4. BEEBE GW, YAMAMOTO T, MATSUMOTO YS, GOULD SE: ABCC-JNIH Pathology studies, Hiroshima-Nagasaki. Report 2. October 1950-December 1965. Hiroshima Igaku 21:729-35, 1968 (ABCC TR 8-67)
5. BEEBE GW, KATO H, LAND CE: Studies of the mortality of A-bomb survivors. 4. Mortality and radiation dose, 1950-66. Radiat Res 48:613-49, 1971 (ABCC TR 11-70)
6. BEEBE GW, KATO H, LAND CE: Studies of the mortality of A-bomb survivors. 6. Mortality and radiation dose, 1950-74. Radiat Res 75:138-201, 1978 (RERF TR 1-77)
7. MILTON RC, SHOHOJI T: Tentative 1965 radiation dose estimation for atomic bomb survivors, Hiroshima-Nagasaki. ABCC TR 1-68
8. ABCC-JNIH: ABCC-JNIH Pathology Studies, Hiroshima-Nagasaki. Research Plan. ABCC TR 12-62
9. ISHIDA M, ZELDIS LJ, JABLON S: Tumor Registry Study, Hiroshima-Nagasaki, Research Plan. ABCC TR 2-61
10. KOSS LG: Tumors of the Urinary Bladder. Washington, D.C., Armed Forces Institute of Pathology, 1975
11. MacMAHON B, PUGH TF, IPSEN J: Epidemiologic Methods. Boston, Toronto, Little, Brown & Co. 1960. pp 224-27
12. LILIENFELD AM: Foundations of Epidemiology. New Jersey, Oxford U Pr, 1976. pp211-12
13. MANTEL N, HAENSZEL W: Statistical aspects of the analysis of data from retrospective studies of disease. J Natl Cancer Inst 22:719-48, 1959
14. PALMER JP, SPRATT DW: Pelvic carcinoma following irradiation for benign gynecological disease. Am J Obstet Gynecol 72:497-505, 1956
15. SMITH PG, DOLL R: Late effects of x-irradiation in patients treated for metropathia haemorrhagica. Br J Radiol 49:224-32, 1976
16. McINTYRE D, POINTON RCS: Vesical neoplasms occurring after radiation treatment for carcinoma of the uterine cervix. J R Coll Surg Edinb 16:141-6, 1971
17. 三輪清三, 師尾 武: 膀胱疾患. 現代内科学大系泌尿器疾患Ⅲ. 東京, 中山書店, 1964年  
(MIWA S, SHIO T: Disease of bladder. Gendai Naikagaku Taikei, Hinyoki-Shikkan III, Tokyo, Nakayama Shoten, 1964)
18. ICHIMARU M, ISHIMARU T, BELSKY JL: Incidence of leukemia in atomic bomb survivors belonging to a fixed cohort in Hiroshima and Nagasaki, 1950-71; Radiation dose, years after exposure, age at exposure, and type of leukemia. J Radiat Res 19:262-82, 1978 (RERF TR 10-76)
19. ISHIMARU T, OTAKE M, ICHIMARU M: Dose-response relationship of neutrons and  $\gamma$  rays to leukemia incidence among atomic bomb survivors in Hiroshima and Nagasaki by type of leukemia, 1950-71. Radiat Res 77:377-94, 1979 (RERF TR 14-77)

20. MCGREGOR DH, LAND CE, CHOI K, TOKUOKA S, LIU PI, WAKABAYASHI T, BEEBE GW: Breast cancer incidence among atomic bomb survivors, Hiroshima and Nagasaki, 1950-69. J Natl Cancer Inst 59:799-811, 1977 (ABCC TR 32-71)
21. CIHAK RW, ISHIMARU T, STEER A, YAMADA A: Lung cancer at autopsy in A-bomb survivors and controls, Hiroshima and Nagasaki, 1961-70. 1. Autopsy findings and relation to radiation. Cancer 33:1580-8, 1974 (ABCC TR 32-72)
22. JABLON S, KATO H: Studies of the mortality of A-bomb survivors. 5. Radiation dose and mortality, 1950-70. Radiat Res 50:649-98, 1972 (ABCC TR 10-71)
23. OTAKE M: Radiation effects on cancer mortality among A-bomb survivors 1950-72. Comparison of some statistical models and analysis based on the additive logit model. J Radiat Res 17:262-321, 1976
24. 昭和50年人口動態統計下巻. 厚生省大臣官房統計調査部. 1975年  
(HEALTH AND WELFARE STATISTICS AND INFORMATION DEPARTMENT, MINISTER'S SECRETARIAT, MINISTRY OF HEALTH AND WELFARE: Vital Statistics in Japan, Volume 2, 1975)
25. STEER A, MORIYAMA IM, SHIMIZU K: ABCC-JNIH Pathology Studies, Hiroshima and Nagasaki. Report 3. The autopsy program and the Life Span Study, January 1951-December 1970. ABCC TR 16-73
26. YAMAMOTO T, MORIYAMA IM, ASANO M, GURALNICK L: RERF Pathology Studies, Hiroshima and Nagasaki. Report 4. The autopsy program and the Life Span Study, January 1961-December 1975. RERF TR 18-78

APPENDIX I CASES OF URINARY BLADDER TUMORS IN THE LSS EXTENDED SAMPLE  
HIROSHIMA AND NAGASAKI, 1961-72

付録1 広島及び長崎の寿命調査拡大集団における膀胱腫瘍例, 1961-72年

MF	Sex	Age ATB	T65D rad	Dx Yr Mon	Age at Dx	MF	Sex	Age ATB	T65D rad	Dx Yr Mon	Age at Dx
Hiroshima											
	F	41	0	69 05	65		F	62	106	58 04	75
	M	24	0	66 05	45		M	59	11	65 04	79
	F	47	0	72 04	74		M	50	3	72 08	78
	F	37	0	64 09	56		M	52	0	68 07	75
	M	65	46	68 08	88		F	44	NIC	65 07	64
	M	49	0	69 06	73		F	50	0	70 01	74
	F	58	0	71 02	84		M	56	2	64 11	75
	M	40	4	60 04	54		F	47	0	57 05	59
	M	47	48	61 05	63		F	47	0	58 02	60
	M	49	218	67 03	71		M	46	0	72 02	73
	M	44	458	71 02	70		F	51	0	66 11	73
	M	52	11	71 06	78		M	49	20	61 10	65
	F	57	18	54 11	67		M	43	0	62 03	60
	F	56	0	70 06	80		M	51	Unk	64 12	71
	F	53	254	66 08	74		F	50	0	62 05	77
	M	42	0	64 04	61		M	42	0	64 07	61
	M	53	11	72 09	80		M	55	Unk	67 09	77
	F	37	0	65 12	57		M	46	0	61 02	61
	M	44	13	72 06	70		M	62	7	62 05	79
	F	37	15	63 08	55		M	51	5	71 09	77
	M	46	0	61 06	62						

## APPENDIX 1 Continued 付録1 続き

MF	Sex	Age ATB	T65D rad	Dx Yr Mon	Age at Dx
Hiroshima, Continued					
	F	46	0	62 10	63
	M	64	0	61 09	81
	M	55	0	66 09	76
	M	51	0	72 06	78
	F	14	0	69 07	38
	M	47	0	62 01	63
	M	45	NIC	69 10	69
	M	44	52	71 07	70
	M	31	74	66 05	51
	F	56	104	61 03	72
	F	47	4	63 03	65
	M	44	142	72 01	71
	F	47	31	67 08	69
	M	49	0	65 02	69
	F	55	0	67 07	77
	M	48	0	67 07	70
	M	39	NIC	70 10	64
	M	38	NIC	71 01	64
	F	1	0	65 03	21
	M	42	NIC	72 11	69

## Nagasaki

	M	37	NIC	65 08	57
	M	41	54	70 05	66
	M	26	1	71 12	52
	M	36	74	61 01	52
	F	47	11	66 05	68
	M	47	44	62 01	63
	M	55	1	72 06	82
	M	47	1	61 01	63
	M	18	72	64 10	37
	M	52	3	70 02	77
	F	41	3	61 03	57
	M	44	43	67 02	65
	F	48	3	64 08	67
	F	46	13	71 05	72
	M	41	31	66 11	62
	F	60	256	66 11	81

MF	Sex	Age ATB	T65D rad	Dx Yr Mon	Age at Dx
	M	54	0	65 05	74
	M	50	NIC	69 01	73
	M	50	NIC	70 09	75
	M	48	NIC	62 12	66
	F	52	NIC	64 12	71
	F	36	NIC	68 04	59
	F	39	NIC	61 08	55
	F	48	NIC	67 05	70
	M	50	NIC	70 07	75
	F	51	NIC	67 07	73
	M	54	NIC	67 01	76
	F	54	NIC	65 04	74
	F	51	NIC	71 06	77
	M	50	NIC	65 11	70
	M	51	NIC	64 01	69
	M	49	NIC	62 02	66
	M	49	NIC	71 03	75
	M	53	NIC	72 02	79
	F	40	NIC	71 08	66
	F	51	NIC	72 03	77

	M	21	Unk	61 04	37
	F	44	0	66 10	65
	F	52	143	71 10	79
	M	30	0	62 07	47
	F	50	0	66 08	71
	M	54	0	60 01	68
	M	41	848	68 11	65
	F	44	NIC	68 08	67
	F	44	NIC	65 03	64
	F	46	20	67 07	68
	M	46	0	70 05	71
	M	51	0	72 06	78
	M	51	118	62 05	68
	M	50	NIC	61 06	66
	M	53	NIC	63 04	70