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[症例報告]Statistical assessment of basal cell carcinoma (BCC) at the Dermatology Clinic of the Ryukyus University Hospital during the 10 year period from 1983 to 1992

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Statistical assessment of basal cell carcinoma (BCC) at the Dermatology Clinic of the Ryukyus University Hospital during the 10 year period from 1983 to 1992

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ABSTRACT

A total of 614 cases of malignant tumors were experienced at the Dermatology Clinic of the Ryukyus University Hospital during the 10 year period from 1983 to 1992. This formed 3.40% of the total of 18075 new outpatients during the period under review. A total of 159 cases of basal cell carcinoma (BCC) were observed, which constituted 26.0% of the total malignant tumors, and 0.88 % of the total new outpatients during the same period. There was an increasing trend in the incidence of BCC in our clinic. The male-female ratio was 1.00 : 1.79, which was different from most of the ratios reported for other university hospitals. The ages ranged from 31 to 99 years with an average of 68.8 years. The age group that frequented most was 60-69 years, representing 30.2 % of the cases. There were 59.1% of the BCC patients whose period of time before lst visit was less than or equal to 5 years. Most of the BCCs were seen on the face (85.5%) and head regions (5.7%). A barely statistically significant exponential correlation was found between the incidence of BCC and the dose of ultraviolet B light (UVB) with the expression :

$\log Y = 3.21 \log U - 4.32$, or $Y = 4.79 \times 10^{-5} \times U^{3.21}$

where Y stands for the incidence of BCC and U for the dose of UVB. *Ryukyu Med. J., 15(4)203~213, 1995*

Key words: statistics, basal cell carcinoma, Okinawa, ultraviolet light (B)

INTRODUCTION

Basal cell carcinoma (BCC) is the most common form of skin cancer. This is true not only in Europe and North America but also in many other countries of the world including Japan. Many institutions have reported statistical surveys of this popular skin cancer with various epidemiologic speculations. In Okinawa, Miyazato first reported the frequencies of malignant skin tumors observed at the Dermatology Clinic of the Ryukyus University Hospital from 1985 to 1991[1]. He presented brief statistics of those malignant skin tumors including BCC with a short, essential comment for each of them. In this study, we try to expand the statistics of the malignant tumors and focus on BCC to present a more comprehensive statistical survey of BCCs histopathologically diagnosed at the same clinic during the 10 year period from 1983 through 1992. We also try to compare the results with those from other university hospitals to get a clear epidemiologic view and an etiological speculation of this common skin cancer.

PATIENTS AND METHODS

All the patients with BCCs who visited the Dermatology Clinic of the Ryukyus University Hospital from 1983 to 1992 were chosen as our subjects for the statistical analysis. The diagnoses of those patients were made ultimately on the bases of histopathological findings as well as on the discussions with the plural colleague dermatologists and pathologists. All the patients whose diagnoses were histologically uncertain were excluded from this study. The patients suspected of BCC but without biopsy specimens were also excluded. The patients with BCCs were grouped according to such variables as age, sex, date of initial visit, site of lesion, duration prior to initial visit, clinical type, histopathological findings and so on with the aid of a personal computer. Test for the proportion for the male-female ratio of BCC and t-test for the simple correlation coefficient between the logarithms of the incidence of BCC and the dose of ultraviolet B light with significance levels: $p \leqq 0.05$ were performed after a regression line between the two parameters had been obtained by

least squares method.

RESULTS

Table 1 shows the number of cases of all the malignant skin tumors observed at our clinic from 1983 through 1992 with the total number of new outpatients in respective years at the bottom of the Table in chronological order. A total of 614 cases of malignant tumors were observed at our clinic during the period under review, which formed 3.40% of the total of 18075 new outpatients during the same period. Table 2 shows the numerical values of the percentages of total outpatients with malignant tumors, the percentages of malignant tumor patients with BCC, and the percentages of total outpatients with BCC, in the respective years. These results are also presented in Fig. 1.

The frequency of BCC ranked first among the malignant tumors in the overall frequency order throughout the period under review, except in 1985 when squamous cell carcinomas (SCCs) outnumbered BCCs. A total of 159 cases of BCC were observed, which represented 26.0% of the total number of 614 cases of malignant tumors and 0.88% of the total number of new outpatients that had come to the clinic in the past 10 years. The frequency of SCCs ranked second with 107 cases and was 17.5% of the total malignant tumor patients and 0.59% of the total new outpatients during the same period. Actinic keratosis ranked third with 91 cases and formed 14.9% of the total malignant tumors and 0.50% of the total new outpatients. Those three kinds of tumors altogether represented 58.4% or more than half of the total number of cases of malignant tumors. The overall ratio of BCCs to SCCs was 159 to 107, i.e., 1.49 to 1, or about 3 to 2.

The incidence of malignant tumors, i.e., the percentage of the total outpatients with malignant tumors showed an increasing trend in the period under review as seen in Fig. 1.

Table 1 The number of cases of all the malignant skin tumors observed at the Outpatient Clinic of the Ryukyus University Hospital during the 10 year period from 1983 to 1992

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	total
Basal cell carcinoma	14	3	9	15	15	16	21	14	30	28	159
Squamous cell carcinoma	6	4	11	11	12	12	12	11	13	18	110
Actinic keratosis	2	1	5	5	7	8	15	14	24	10	91
Bowen's disease	6	3	3	10	5	5	12	7	5	5	61
Adult T cell leukemia	0	2	14	10	6	1	7	3	7	6	56
Malignant melanoma	0	0	4	5	2	4	2	7	4	3	31
Malignant lymphoma	2	5	3	6	0	0	2	0	0	4	22
Metastatic skin cancer	1	0	1	1	6	1	4	1	5	2	22
Paget disease	2	0	1	1	1	1	2	0	6	1	15
Malignant Hemangioendothelioma	0	0	0	0	2	0	0	3	1	2	8
Sebaceous carcinoma	0	0	0	3	0	0	0	0	5	0	8
Sweet gland carcinoma	0	0	1	0	0	0	2	3	1	0	7
Malignant fibrous histiocytoma	0	0	0	1	1	1	0	1	3	0	7
Leukoplakia	1	1	0	1	0	0	0	0	0	0	3
Kaposi's saroma	0	0	1	0	1	0	1	0	0	0	3
Malignant schwannoma	0	0	0	0	0	1	0	0	1	0	2
Dermatofibrosarcoma protuberance	0	1	0	0	0	0	0	0	0	0	1
Others	0	1	0	0	0	0	0	0	2	8	8
Total	34	21	53	69	58	50	80	64	105	80	614
No. of new outpatient	1,701	1.060	1,856	2,003	1,662	1,803	1,911	2,130	2,300	1,649	18,075

Table 2 The numerical values of the percentages of the total outpatients with malignant tumors, the percentages of the total malignant patietns with BCC, and the percentages of the total outpatients with BCC

year	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	overall average
% of total outpatients with malignant tumors	2.0	2.0	2.9	3.4	3.5	2.8	4.2	3.0	4.5	4.9	3.4
% of malignant tumor patients with BCC	41.2	15.0	17.0	21.7	25.9	32.0	26.2	22.2	26.9	30.0	26.0
% of total outpatients with BCC	0.82	0.28	0.48	0.75	0.90	0.89	1.10	0.66	1.22	1.46	0.88

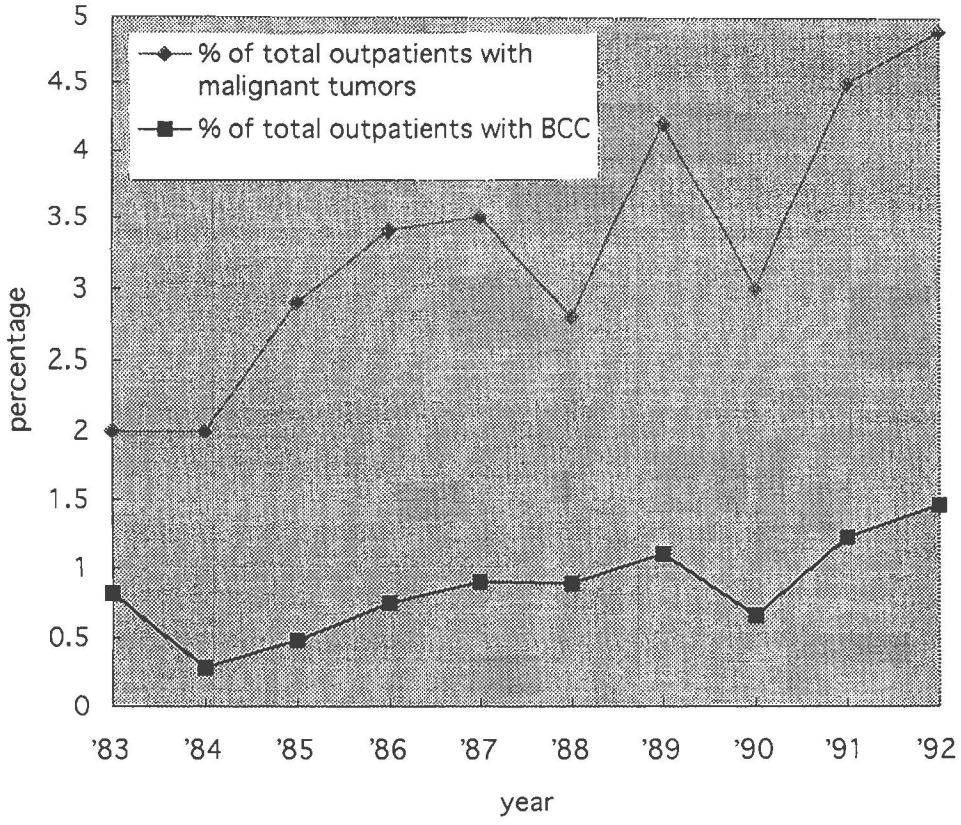

Fig.1 The percentages of total outpatients with malignant tumors, and the percentages of total outpatients with BCC.

Table 3 The distribution of the number of the patients with BCC by age range (5 years interval), sex and period before initial visit

year	83		84		85		86		87		88		89		90		91		92		total			
Age	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	(%)	(%)
0～4																								
5～9																								
10～14																								
15～19																								
20～24																								
25～29																								
30～34											1										1	2	3(1.8)	7(4.4)
35～39										2				1				1		1		4	4(2.5)	
40～44										1								2				4	4(2.5)	8(5.0)
45～49										2					1	1			1		2	2	4(2.5)	
50～54		1			1			3		1	3					1				1	4	6	10(6.3)	19(11.9)
55～59						1	1								1	1		3	1	1	3	6	9(5.7)	
60～64	1	1			1	1	2	1	1		1	1	4	3	1		2	2		3	13	12	25(15.7)	48(30.2)
65～69		1	1		1		1	2		1				2			4	4	2	4	9	14	23(14.5)	
70～74	1	1		1	1		1			3		1	1	4	1	1	2	1	1	1	8	13	21(15.7)	38(23.9)
75～79								1	1	1	2	2		2	2	2		2	1	1	6	11	17(10.7)	
80～84		3		1	1			1				2		1			2	2			3	10	13(8.2)	30(18.9)
85～89	1	2				2		1		1	1	1	1	1	1	1			2	2	6	11	17(10.7)	
90～94	1	1						1				1		1			1			1	2	5	7(4.4)	9(5.7)
95～99									1											1	1	1	2(1.3)	
100～104																								
Total	4	10	1	2	5	4	5	10	3	12	8	8	6	15	7	7	11	17	8	16	58	101	159(100)	159(100)

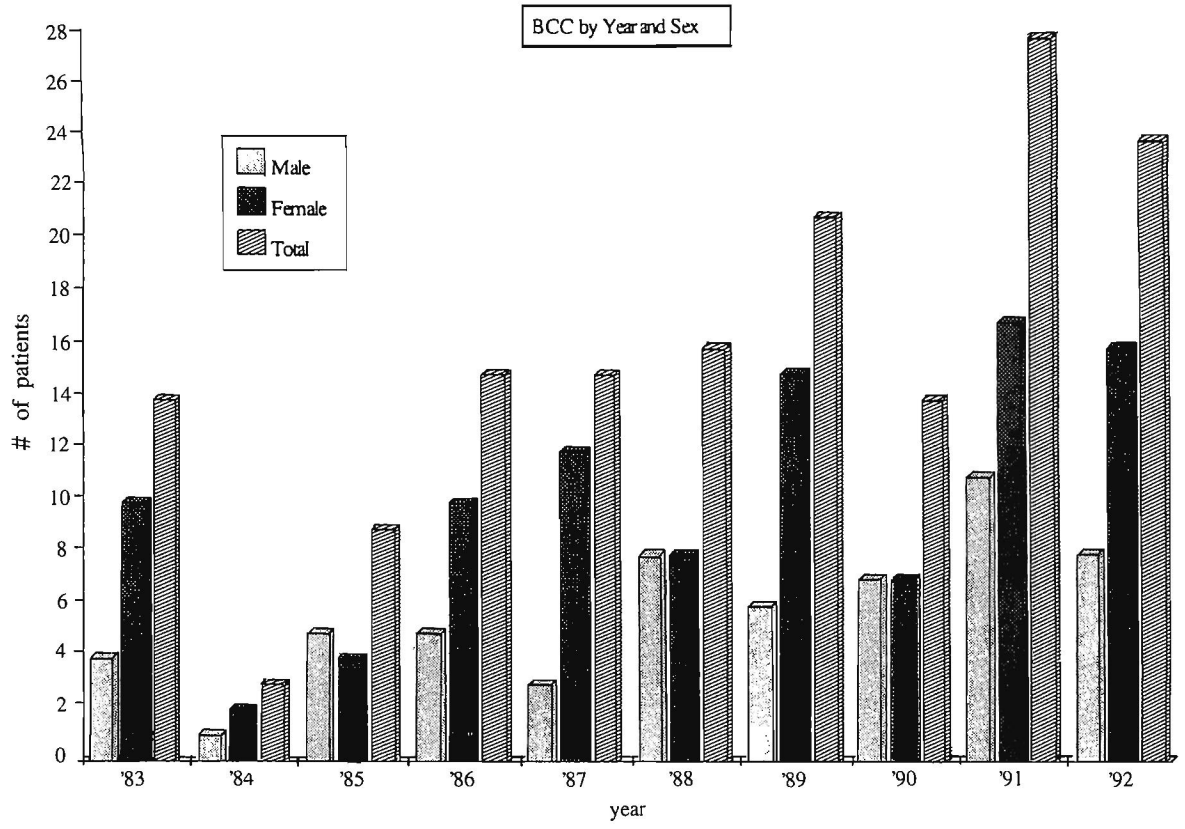

Fig.2 The distribution of the number of patients with BCC by sex and year of initial visit.

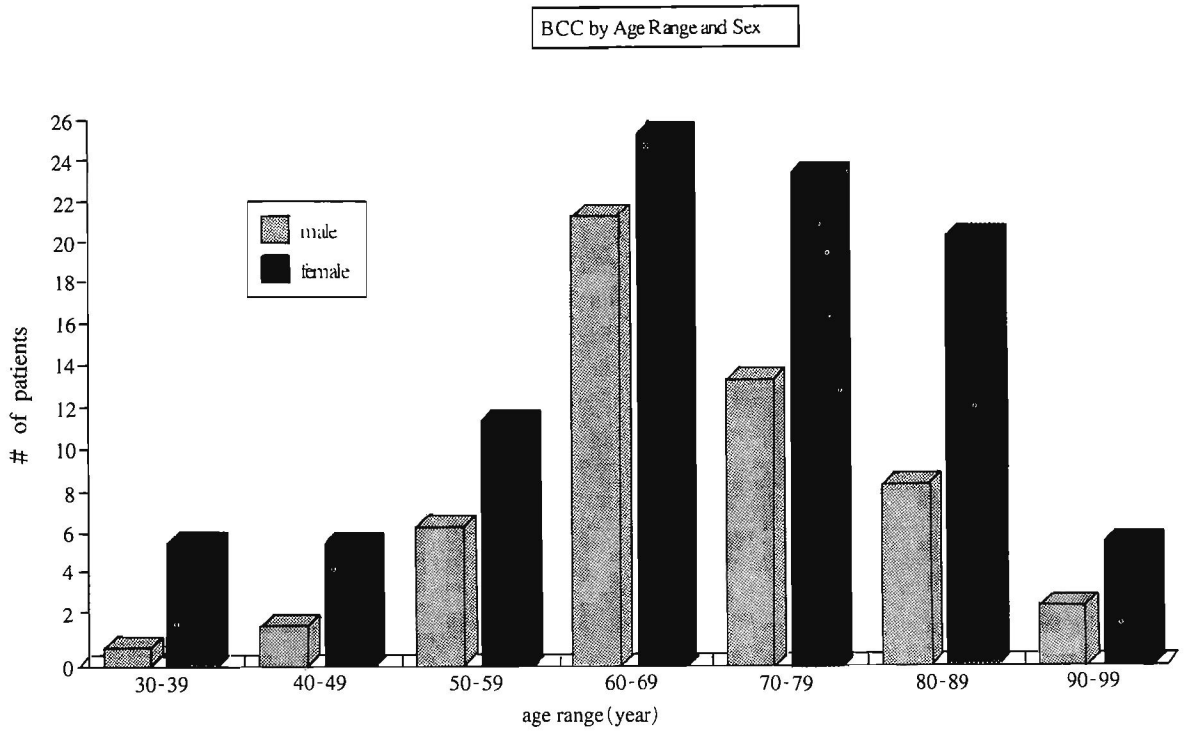

Fig.3 The distribution of the number of patients with BCC by sex and age range (10 years interval).

This was also true with the incidence of BCC as well as with that of SCC. However, the augmentation rate resulting from the increase in the incidence of BCC was larger than that from the incidence of SCC. That is, in the first half (1983-1987) of the total period under review, the incidence of BCC was 0.68%, while that of SCC was 0.52%. In the latter half (1988-1992), the incidence of BCC increased to 1.1%, i.e., 1.62 times over that of the first half, while that of SCC increased only to 0.65%, i.e., 1.25 times over that of the first half.

Table 3 shows the distribution of the BCC patients according to age range (5 years interval), sex, and year of lst visit. The last column shows the sum of the patients with BCC in each ten year group from the fourth to the tenth. The numbers in parentheses in that column show the relative percentages of the total BCC patients in each group. The highest frequency occurred in the 60-69 years group forming 30.2% of the total patients with BCC. It should be noted that the 30-39 years age group, a younger generation, represented as high as 4.4% of the total BCC patients. The patients aged 70 years or more represented 48.5%, or about half of the total patients with BCC.

The overall male-female ratio of BCC in our clinic was 57 to 102, or 1.00 to 1.79, i.e., 36% to 64% indicating more females than males (Fig. 2, 3). There was no correlation between the sex difference and the age groups.

The ages of the patients with BCC in our clinic ranged from 31 years to 99 years with an average age of 68.8 years

Table 4 The distribution of the patients with BCC by period of time before initial visit and age range

Year / Age	>1	1~3	3~5	10<	20<	unknown
0~4						
5~9						
10~14						
15~19						
20~24						
25~29						
30~34	1					2
35~39	1	1		1		1
40~44		1			1	2
45~49	1	2	1			
50~54	1	3				3
55~59		3	1	1	2	
60~64	5	5	3	3	2	3
65~69	3	7	6	1	1	3
70~74	6	4	1	2	1	2
75~79	3	3	5	3		3
80~84	2	6	2			2
85~89	2	6	2	1	1	3
90~94	2	4				
95~99				1		1
100~104						
Total (%)	27 (17.0)	45 (28.3)	22 (13.8)	12 (7.5)	8 (5.0)	25 (15.7)

Table 5 The distribution of the patients with BCC by site of lesion and age range

Year / Age	head	face	neck	trunk	upper extremity	lower extremity	external genitalia
0~4							
5~9							
10~14							
15~19							
20~24							
25~29							
30~34	1	2					
35~39		2					
40~44		4					
45~49		4					
50~54		7	1	1	1		
55~59	2	6		1			
60~64	2	19		3			
65~69	1	21	1				
70~74	1	19		1			
75~79		13		2			1
80~84	1	11	1				
85~89	1	16					
90~94		7			1		
95~99		1					
100~104							
Total (%)	9 (5.7)	132 (85.5)	3 (1.9)	8 (5.0)	2 (1.3)		1 (0.6)

Table 6 The sub-distrbution of BCC on the face. The percentages shown at the bottom of the table are those for each facial region against the grand total of BCC

Year / Age	forehead	ear	orbital sulcus	nose	cheek	nasolabial sulcus	lip region	chin	
0~4									
5~9									
10~14									
15~19									
20~24									
25~29									
30~34	2								
35~39			1	1					
40~44	1	1		1	1				
45~49				2	2				
50~54		1	1	3	2				
55~59			2	2	1		1		
60~64	2		2	9	5			1	
65~69	1	2	7	3	6		2		
70~74	3		4	9	1	1		1	
75~79		1	2	5	1	2	2		
80~84	1	1	3	2	3		1		
85~89	2	1	3	4	5	1			
90~94	1		1	3	2				
95~99				1					
100~104									
Total	13	7	26	45	29	4	6	2	Total 132
(%)	(9.8)	(5.3)	(19.7)	(34.1)	(22.0)	(3.0)	(4.5)	(1.5)	(100)

(Fig. 3).

Table 4 shows the distributions of the patients with BCC by length of time prior to lst visit and age group. More than a quarter of the patients, i.e., 28.3% first visited the clinic 1-3 years after the onset of lesions. 59.1% of the BCC patients took up to 5 years to first visit the hospital from the onset of the lesions while 17% waited less than one year to visit.

Table 5 shows the distribution of the patients with BCC according to age range (5 years interval) and site of lesions. The whole body was conventionally divided into 7 regions as head, face, neck, trunk, upper extremity, lower extremity, and external genitalia. Most of the BCCs were seen on the face and head regions with 85.5% and 5.7%, respectively. There was no correlation between the site distribution and the age ranges.

Since majority of the lesions occurred on the face (85.5 %), it was divided into 8 portions. These are forehead, ear, orbital region, nose, cheek, nasolabial sulcus, oral region, and chin. Table 6 shows the sub-distribution of the BCC on the facial regions. The percentages shown at the bottom of the table are those of each facial region against the grand total of BCC. It is clear that the BCCs occurred mostly around the nose, cheek, and orbital regions. It is interesting to note that these regions correspond to the lines of the embryonal facial fissures.

Table 7 shows the distribution of the clinical types of BCCs observed at our clinic during the period under review with their relative percentages in parentheses. Although there were 10 cases of multiple types, the total number of clinical types amounted only to 161. This is because some of the multiple cases showed only one clinical type, thus resulting in fewer cases. Each of the recurrent cases was counted as one clinical type unless it showed more than two different clinical types. The above mentioned relative

Table 7 The distribution of clinical types and the numbers of multiple and recurrent cases of BCC

clinical type	no. of cases (%)
Nodular	91(56.5)
Ulcerative	2(1.2)
Nodulo-ulcerative	45(28.0)
Superficial	14(8.7)
Superficial-ulcerative	1(0.6)
Morphea-like	2(1.2)
Organoid-nodular	1(0.6)
Unknown	5(3.1)
Total	161(100.0)
(Multiple type included)	
Multiple type	10(6.3)
Recurrence	5(3.1)

Table 8 The distribution of the histopathological types and the number of metastatic cases of BCC

histopathological type	no. of cases (%)
Solid	100(62.1)
Adenoid	21(13.0)
Cystic	6(3.7)
Keratotic (pilar type)	3(1.9)
Superficial	9(5.6)
Morphea-like (fibrosing)	1(0.6)
Fibroepithelioma	0(0.0)
Mixed	21(13.0)
s+a	9(5.6)
s+c	2(1.2)
s+k	3(1.9)
s+fibrosing	2(1.2)
s+syringoid	1(0.6)
s+a+c	3(1.9)
s+a+k	1(0.6)
Metastatic case	1(0.6)
Total	161(100.0)

percentages were calculated against this total of 161. Majority of the cases were nodular type which constituted 56.5% of the total. Nodulo-ulcerative type formed 28.0 % of the total. These two types together represented 84.5 % of the total. Superficial type formed 8%, multiple type, 6.3%, and recurrence type, 3.1%.

Table 8 shows the distribution of the histopathological types of BCC observed at the clinic. Most were solid type (62.1%), followed by adenoid type (13%), mixed type (13%), and superficial type (5.6%). Among the mixed types, the combination of solid type and adenoid type was the most common (5.6%). One rare instance of metastatic case of BCC was observed.

DISCUSSION

There have been no data regarding the incidence of BCC in the general population of Japan. However, mass surveys for skin cancer have been sporadically conducct-ed. According to the one conducted in Yamaguchi Prefecture during the past 16 years from 1963 to 1978, the ratio of the number of patients with skin cancer to that of the total examinees was 29 (15 from BCC) to 1824, i.e., 1.6% (0.82% from BCC) of the examinees had revealed skin cancers[2]. The figure was considerably higher than the average incidence of skin cancer, which was approximately 0.2%, at a dermatology clinic of a university hospital during the period from 1971 to 1975[3]. Hiramoto et al. conducted another mass survey for skin cancer in Ibaragi Prefecture in 1984, reporting the ratio of two skin cancer patients (one from BCC) to 77 examinees, i.e., 2.6% (1.3 % from BCC) of the examinees had skin cancers[4]. This figure was also much larger than the average incidence of skin cancer at university hospitals during the corresponding years[5]. The reason for the differences may partially be due to a bias in the basic population that the surveys covered. That is, it seems reasonable to assume that people who joined the mass surveys must have been very much interested in skin cancer and maybe had had some sorts of skin tumors beforehand, while outpatients at a general dermatology clinic show a variety of skin diseases.

In the United States, the incidence of BCC in the general population has been reported to be 500 to 1000 per 100,000 (0.5% to 1%)[6]. It is higher in the sunbelt. The National Cancer Institute has estimated an annual incidence of 400,000 new cases of BCC in the U.S. alone[7]. Carter et al. stated that the reported incidence of BCC in the U.S. had increased more than 18% between 1971 and 1977[8]. The ratio of BCC to SCC among whites is at least 2 : 1[7]. Olbricht et al. state that BCC was 70-80% of the total incidence of malignant skin cancer in the U.S., while in Japan the disease was only 51.1% of all the malignant skin cancers of the epidermis[9,10].

Ohtsuka and Watanabe state that the incidence of BCC is approximately one out of 1,000 new outpatients (0.1%) in an ordinary dermatology clinic of a Japanese university hospital[11]. According to the nationwide survey by Tada and Miki, the incidences of skin cancer in university hospitals between 1971 and 1975 had increased 2 to 2.5 times over those of the previous survey undertaken by Miyaji between 1956 and 1960[3]. More specifically, they reported that the number of' patients with BCC increased 4.7 times over that of the previous survey, 15 years earlier. According to Ikeda et al., the number of patients with BCC treated at Saitama Medical School and National Cancer Center between 1973 and 1985 increased 1.8 times over that between 1962 and 1972[12]. They continuously reported the survey of skin cancer at Saitama Medical School between 1983 and 1992, in which they stated that the incidence of BCC had stabilized for the past 10 years with mild fluctuation[5].

The increase in the incidence of BCC was larger than that of SCC in our survey. This was true especially with the statistics from the recent years. The same trend had been reported from most of the other university hospitals in Japan[5,13-15].

To compare the incidences of BCC at university hospitals more specifically, the following have been reported: the incidence of BCC among new patients at the Dermatological Clinic of Yamagata University was 0.3% during a 10 year period from 1976 to 1986[16]; the Department of Dermatology of Dokkyo University reported the incidence of 0.19% among new patients during a 20 year period from 1974 to 1993[17]; the Department of Dermatology of Yokohana Municipal University reported the incidence of 0.21% among new patients during a 10 year period from 1981 to 1990[18]; the Department of Der-

matology of Kurume University reported the incidence of 0.41% among new patients during a 14 year period from 1976 to 1989[19]. In our clinic, the incidence of BCC among the new patients was 0.88% during the 10 year period from 1983 to 1992 (Table 2), which was much larger than the figures from the other university hospitals mentioned above.

About half of the patients with BCC, 48.5%, were 70 years or older in our survey (Table 3). This was slightly higher than the corresponding data, 44.4%, from the nationwide questionnaire survey on skin cancer by the Japan Skin Cancer Association in 1994[9]. According to Hiramatsu et al., the patients whose ages were less than or equal to 30 years formed 3.8% of the total 1047 cases of BCC in the 11 university hospitals they investigated[20]. However, there were no patients whose ages were less than or equal to 30 years in our hospital.

The overall male-female ratio of BCC in our clinic was 1.00 to 1.79. This showed a significant sex difference in the occurrence of BCC, compared with the result of the nationwide questionnaire survey mentioned above ($p<0.05$, test for the proportion)[9]. Ehime University Hospital reported a male-female sex ratio of 116 : 133 among the BCC patients during the past 16 years[11]. This, however, showed no statistically significant difference. Our result was contrary not only to the above two results but also to many of the corresponding statistics from the university hospitals, which stated that BCCs occurred more often in men than in women or at least they occurred equally in both sexes[5,13-15].

59.1% of the patients in our survey took up to 5 years from onset of BCC to lst visit the hospital. This figure was slightly smaller than the 61.4% reported by the nationwide questionnaire survey in 1994[9]. Dokkyo Medical University reported that 18.2% of the patients with BCC took up to one year before their lst visit[17], whereas Kitasato University Hospital reported a figure of 5%[21]. These data including ours (17%) clearly confirm the well-known fact that BCC is a slow growing tumor. Incidentally, the proportion of the SCC patients who took less than a year for their first visit was reported as 60.6% by Wada et al[22].

Ohtuka et al. stated that nodulo-ulcerative type constituted 83.2% of the BCCs collected from 15 institutions in Japan[11]. Our figure, 84.5%, was almost equal to this.

Superficial type formed 8%. This was slightly smaller than the average, since most of the corresponding statistics from other institutions reported a figure of more than 10% in their surveys[11,17].

The nationwide questionnaire survey reported the incidence of multiple type as 6.3%, which was exactly the same as ours[9]. The incidence of recurrence type in ours was almost the same as that of Ehime University Hospital, 3.3%, and close to those from other institutions[11].

According to the nationwide questionnaire survey, there were 5 cases of distant metastasis of BCC, which was 0.26% of the total 2806 registered cases[9]. Our data together with those confirmed the rareness of metastatic BCC.

The reasons for the high incidence of BCC in Okinawa are unclear. However, we suggest that one reason for this may be due to the difference in the dose of natural ultraviolet ray (UV) radiation among the university hospitals with their varying locations with respect to the Northern Latitudes (NL). As for the etiology of BCC, many dermatologists assert that UV radiation is an important factor in the development of BCC, and much of the epidemiologic and experimental data concerning its role in the production of SCC also pertain to BCC[7], the relationship between sun exposure and neoplasia being less direct with BCC than with SCC[8]. Tada et al. stated that the incidence of skin cancers (SCC and BCC) on exposed sites without preceding diseases among dermatology patients in university hospitals of Japan showed a statistically significant exponential correlation with decreasing degrees of the NL[3]. Naganuma et al. stated that there was a statistically significant exponential correlation between the dose of UVrays and the degree of NL[23]. If those assertions are true, it would seem natural that the incidence of BCC in Okinawa is higher than those in other areas of Japan since it is located in the southernmost region of Japan.

In 1991, Japan Weather Association reported the geographic distribution of ultraviolet B light (UVB) intensity measured at several big cities in Japan such as Sapporo, Tsukuba, Kagoshima and Naha (Table 9). On the basis of this, we found that there was a statistically significant exponential correlation between the dose of UVB and the degree of NL with the regression line as follows :

$$\log U = -0.0158X + 1.73 \quad (p<0.02, \text{t-test})$$

where U was the annual average of the daily accumulated UVB dose (kJ/m^2), and X was the degrees of NL. (The values of U were calculated as the annual arithmetic mean of the monthly averages of the daily accumulated UVB doses measured at the above mentioned four cities in 1991.) However, we only found an exponential correlation between the incidences of BCC against the new dermatological outpatients and the degrees of NL, which was barely

Table 9 The distribution of ultraviolet B light intensity in Japan in 1991 (The Japan Weather Association)

	Monthly average of daily accumulated UVB dose (KJ/m^2)			
	Sapporo	Tukuba	Kagoshima	Naha
Jan.	1.80	5.41	8.03	10.37
Feb.	3.57	8.52	10.49	13.43
Mar.	8.04	10.55	14.10	15.93
Apr.	11.64	17.43	17.28	20.93
May.	19.63	20.73	17.36	29.70
Jun.	22.43	22.17	18.25	35.54
Jul.	22.96	19.97	27.32	36.21
Aug.	22.99	23.64	26.24	31.86
Sep.	14.32	15.34	21.53	27.61
Oct.	7.37	8.96	14.94	18.20
Nov.	3.17	7.58	11.55	13.38
Dec.	1.86	4.72	6.52	11.66

statistically significant. That is, on the basis of the incidences of BCC reported from the above mentioned university hospitals[16-19], it was found that there was an exponential correlation between the two factors with the regression line as follows :

$$\log Y = -0.0507X + 1.23 \ (p \leqq 0.05, \text{t-test})$$

where Y was the incidences (%) of BCC against the new dermatological outpatients and X was the degrees of NL. Although the correlation coefficient was not positively significant, it may safely be stated that it was barely statistically significant by the routine t-test with $p \leqq 0.05$. Therefore, it was concluded, from these two expressions, that the incidence of BCC was expressed as follows :

$$\log Y = 3.21 \log U - 4.32 \text{ or}$$

$$Y = 4.79 \times 10^{-5} \times U^{3.21}$$

where the incidence of BCC (%) was proportional to the approximate cube of the annual average of the daily accumulated UVB dose (kJ/m^2). It should be remembered, however, that the incidences of BCC used in the calculation were simply the ratios of the patients with BCC to the numbers of the total new dermatological outpatients. They were not based on the total general patient population that each university hospital had. Although they do not necessarily represent the true incidences of BCC in each area of Japan, they seem to approximate the true incidences better than any other variables so far. Tada et al. stated that the incidence of skin cancers paralleled the approximate square of the UV dose, presenting the equation as follows :

$$Y = 2.09 \times 10^{-9} \times U^{1.89}$$

where Y stands for the incidence of skin cancers and U for the dose of ultraviolet rays[3]. However, the incidence of skin cancers in this equation included the portion contributed by SCC, which was almost the same as that of BCC (0.080% for SCC and 0.091% for BCC). Regardless of those biases in both equations, it seems apparent that the geographic difference in incidence of BCC was influenced by the UVB dose. On the basis of this, we speculate that there should be some relation between the incidence of BCC and the UVB radiation.

The incidence of BCC is increasing in North America and Australia as well as in many countries of the world today[8,24]. The incidence shows an increasing trend in Japan, too, according to the nationwide questionnaire survey on skin cancer by the Japanese Skin Cancer Association in 1994[9]. Our outpatient clinic observed roughly the same trend as this (Fig. 1). The reasons for this trend are unclear yet. Since UV radiation is generally accepted to be the dominant environmental risk factor for the disease, it was presumed that the increase in the incidence might be related to the increase in UV radiation on the earth. However, there has been no increase in UVB on the surface of the earth according to Scotto who actually measured UVB at many areas of the U.S. from 1974 to 1985[25]. The Japan Weather Association has not reported any further chronological data of UVB measurement than the one mentioned above. Therefore, it is not clear yet, at least in Japan, whether the UVB intensity has actually changed or not. For these reasons, it can not be concluded yet whether the UV radiation should be the major cause for the increase in the incidence of BCC. It is therefore plausible that some other factors could influence the incidence of BCC besides the UV radiation, such as the increase in the aged population or the heightened awareness about skin cancer that stimulate

Table 10 Corrected site distribution of BCCs by surface area of the body

Site	absolute frequency	relative frequency (a : %)	order by relative frequency	surface area (b : %)	a/b	corrected relative frequency a/b in % (c : %)	order by corrected relative frequency
1. head	9(94)	5.7(6.0)	2(3)	3.5	1.629(1.714)	5.9(6.6)	2(2)
2. face	136(1154)	85.5(73.9)	1(1)	3.5	24.429(21.114)	87.8(81.8)	1(1)
3. neck	3(32)	1.9(2.1)	4(5)	2	0.950(1.050)	3.4(4.1)	3(4)
4. trunk	8(194)	5.0(12.4)	3(2)	31	0.161(0.400)	0.6(1.5)	5(5)
5. upper extremity	2(24)	1.3(1.5)	5(6)	19	0.068(0.079)	0.2(0.31)	6(6)
6. lower extremity	0(42)	0(2.7)	7(4)	40	0(0.068)	0(0.26)	7(7)
7. external genitalia	1(22)	0.6(1.4)	6(7)	1	0.6 (1.400)	2.2(5.4)	4(3)
Total	159(1562)	100.0(100.0)		100.0	27.837(25.825)	100.0(100.0)	

( ) indicates the results based on the accumulated data from 15 university hospitals during 1973-1991
b: surface area by Lund-Browder's law

more frequent visits to the hospital. Further epidemiological clarification is needed.

With respect to the site distribution of BCC, the nationwide questionnaire survey on skin cancer revealed that in 1986, 71% of all the reported 2806 cases occurred on the face, and therefore concluded that it was undeniable that there was a certain relationship between the incidence of BCC and sunlight[9]. The accumulated data from 15 university hospitals during the period from 1973 to 1991 showed that 73.9% of BCC occurred on the face[26], which was almost the same percentage as the one reported by the Japan Skin Cancer Association (Table 10). Statistics at our clinic showed that the face formed 85.5% of the relative frequency of BCC (Table 5, 10). The figure was much larger than any other corresponding data from the other university hospitals in Japan. This was true for the corrected relative frequency by the surface area of the body, which is shown in the column "c" of the Table 10[26]. (Each figure in the column of "relative frequency (a)" was divided by the corresponding figure in the column of "surface area (b)" to get the figures in the column "a/b". The figures in the column "c" were calculated as the relative percentages of the figures in the column "a/b", i.e., each figure in the column "a/b" was divided by the sum of the column "a/b" and multiplied by 100.) The true reason why Okinawa revealed the high relative frequency of BCC on the face is unclear. However, this fact could be interpreted as another supportive evidence for the speculation that the geographic difference in incidence of BCC was influenced by the dose of UV radiation which varies depending on the NL. Incidentally, it was reported in Bangkok (about 14 degrees of NL) that 72.8% of BCC occurred on the face[27], which, corrected by the above method, give 94.4%.

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