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Does Prompt Treatment of Hypertension after Blood Pressure Check-ups Reduce Morbidity of Cerebrovascular Diseases?

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Abstract

In Japan, more than 20 million people utilize blood pressure check-up services in their work places or communities every year. To examine the relationship between prompt treatment of hypertension after these blood pressure check-ups and the severity, age at onset, and type of cerebrovascular diseases in these patients, a study was performed with the cooperation of all 174 independent physicians, 17 hospitals, and 4 welfare homes in the city of N.. All patients aged 50 years or more who visited a physician during the study period in this city were included in the study (n=978). Information on hypertensive control before the onset of cerebrovascular diseases was obtained from 668 patients. The results suggests that for those who had received prompt treatment after early detection of hypertension, the disease was less severe and the onset of the disease was delayed. Among our subjects, 47% of the patients claimed to have received prompt treatment after detection of hypertension. As N. is an ordinary Japanese city in terms of the promotion of health check-up programs, this percentage suggests that blood pressure check-up programs for the early detection of hypertension throughout Japan may have contributed to an overall reduction in severity for almost half of the patients with cerebrovascular diseases.

Key words: Blood pressure check-up, Cerebrovascular diseases, Early detection, Hypertension, Prompt treatment

Introduction

Cerebrovascular disease accounted for the highest mortality rate of all diseases in Japan during the 30 years between 1951 and 1980: 125.2 per 100 thousands persons in 1951 and 139.5 in 1980. Average annual age-adjusted mortality rate of cerebrovascular disease for 1967 through 1973 was highest in Japan and Portugal, and lowest in the Philippines, Poland, and Mexico among the 33 countries listed by Fratiglioni et al.[1]. To counter this high mortality rate, health check-ups in Japan for early detection of hypertension together with health education or counseling for people having this condition have been promoted in the recent decades to ensure prompt treatment for the disease[2]. Periodical health check-ups for workers are stipulated in work places by the Labor Safety and Health Act 1972. More than 10 million people received health check-ups at 64,237 work places in 1990. Among these, 7.1% showed abnormal findings in blood pressure and 6.2% on ECG. General health check-ups for residents aged 40 years or over have been promoted since 1983 in the communities by the Health Services for the Elderly Act 1982. About 9.3 million people received such check-ups in Japan nationwide in 1991, constituted a usage rate of 33.1%. Hypertension and abnormal ECG was found in 1.3 million and 1.4 million people, respectively[3]. In mortality from cerebrovascular diseases, a large decrease was observed in the past twenty years, from 175.8 in 1970 to 99.4 per 100 thousands in 1990, while life expectancy had increased by 1.87 years for men and by 2.56 years for women during the same period[4]. Marmot and Smith[5] emphasized the need for studies to find out whether the Japanese public health system has affected recent improvements in health.

Komachi et al.[6] reported, in 1984, that the incidence of all types of stroke in Japan during the period 1975-1979 appeared to have decreased in comparison with that during 1960-1969. Iso[7] reported, in 1986, that in a rural town, after a long-term program based on health check-ups for prevention of stroke, there was a large decrease in the standardized mortality ratio for stroke from 1969-1973 to 1978-1982. Kojima et al.[8] also reported in 1990 on the characteristics of prognosis and disability of stroke patients in Japan. A report by Miyake[9] in 1993 showed that the incidence and mortality of stroke declined along with a decrease in systolic blood

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pressure levels in a rural town from 1969-1972 to 1981-1984. We showed that improvement indices for rate of use of check-ups correlated with mean bed days and mean inpatient fee for elderly residents aged 70 or older, and suggested that strong health service programs starting from middle age decreased the demand for inpatient care of the elderly[2]. However, as these studies compared groups rather than individuals, the relation between health check-ups and mortality or morbidity in cerebrovascular diseases does not necessarily indicate causal[10].

To study the relationship between prompt anti-hypertensive treatment and severity in cerebrovascular diseases, we examined whether patterns of hypertensive control before onset of cerebrovascular diseases were related to the severity, age at onset, and type of disease, with the cooperation of all physicians in a city in Osaka prefecture. In addition, we wanted to show whether the blood pressure check-ups which promoted early detection of hypertension might contribute to the improvements in health of the population in Japan.

Methods

All cerebrovascular patients aged 50 years or over as of 1 January 1992, who received treatment as outpatients or inpatients between 16 January and 13 February 1992, at any of all 174 physicians' clinics, 17 hospitals, and those admitted to welfare homes for the elderly in the city of N. (population: 255,814 in 1992) were included as subjects in the study. The study included both patients who visited the physician for the first time during the study period as well as those who had visited before the study period. The total number of patients reported on was 978. A total of 668 patients provided information on hypertensive control before the onset of cerebrovascular disease, in the format of questionnaire. Patterns of hypertensive control before the onset of disease were classified as follows: in the "normotensive" group, hypertension was not seen during a check-up before the onset of cerebrovascular disease; "promptly treated" group received treatment after hypertension was detected during a check-up before the onset of cerebrovascular disease. For the "unchecked" group, blood pressure levels were unknown because the subjects had not had health check-up. Finally, in the "untreated" group, hypertension was detected during a check-up before the onset of cerebrovascular disease, but was not treated until the onset of the disease. Here, blood pressure check-ups did not only include those provided for by the Labor Safety and Health Act or the Health Services for the Elderly Act, but also the casual check-ups provided at physicians' clinics.

Percentage of the subjects classified by the pattern of hypertensive control before onset was compared with the degree of restriction in daily living activities, type of paralysis of the extremities, need for rehabilitation therapy, and category of the disease. Mean age at onset of cerebrovascular disease classified by the pattern of hypertensive control before onset was also compared with the category of the disease.

Assessment of the degree of restriction in daily living activities, the type of paralysis of the extremities, the need for rehabilitation therapy and classification of the disease was made by the attending physician for each of the subjects. Need for rehabilitation therapy were classified by the frequency of the therapy into three categories: regularly, occasionally and almost no need. Cerebrovascular diseases were divided according to the International Classification of Diseases (9th revision): cerebral hemorrhage (Code No. 431), subarachnoid hemorrhage(Code No.430) and cerebral infarction (Code No.434). Other disorders that could not be classified clearly into one of the three categories were stated as 'other'. Computed tomography was used for the diagnosis of 668 patients (69% of all patients reported), and of 469 patients with information on hypertensive control before the onset of the disease (71% of all patients with such a history).

Data analysis was performed with the SPSS-X (version 6.1) at the Osaka University Computer Center.

Results

The number of subjects for each hypertensive control before onset by age and sex is shown in Table 1. Of those whose information on hypertensive control was provided, 47% (313 people) were promptly treated whereas 12% (77 people) were untreated. There was not a significant difference of the distribution by sex nor between the age groups.

As shown in Table 2, the percentage of subjects with cerebral hemorrhage in the normotensive or promptly treated groups was nearly half of that for the unchecked or untreated groups. Although the number of patients with subarachnoid hemorrhage was relatively small in all the groups of hypertensive control, the percentage of patients with this disease was the smallest in the promptly treated group and was the largest in the untreated group. The percentage of subjects with cerebral infarction was nearly the same in all four groups. Other disorders accounted for a larger percentage in the normotensive and promptly treated group than in two other groups.

The mean age of subjects at the onset of cerebrovascular dis-

Table 1 Number of patients with cerebrovascular disease classified by the pattern of hypertensive control before onset.

Age (years old)	Pattern of hypertensive control before onset: Normotensive[a]			Promptly Treated[b]			Untreated[c]			Unchecked[d]			Total			All subjects reported[e]		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
50-59	7	4	11	15	13	28	6	8	14	12	10	22	40	35	75	63	49	112
60-69	22	9	31	48	35	83	16	6	22	29	8	37	115	58	173	157	77	234
70-79	16	20	36	55	75	130	14	9	23	29	26	55	114	130	244	169	188	357
80-89	9	12	21	24	44	68	8	10	18	20	30	50	61	96	157	90	155	245
90+	1	4	5	1	6	7	0	1	1	0	6	6	2	17	19	5	25	30
Total	55	49	104	143	173	316	44	34	78	90	80	170	332	336	668	484	494	978

[a] Hypertension was not seen during a health check up before the onset of cerebrovascular disease.
[b] Hypertension was detected and had a prompt treatment by a physician before the onset.
[c] Hypertension was detected, but was not treated before the onset.
[d] Blood pressure levels were unknown because the subjects had not had a health check up.
[e] Including subjects whose information on hypertensive control before the onset was not provided.

Table 2 Patients with cerebrovascular disease classified by category of the disease and pattern of hypertensive control before onset.

Pattern of hypertensive control before onset	Category of cerebrovascular disease: Cerebral hemorrhage % (n)	Subarachnoid hemorrhage % (n)	Cerebral infarction % (n)	Others % (n)	Total % (n)
Normotensive	10 (10)	4 (4)	61 (63)	26 (27)	100 (104)
Promptly Treated	9 (27)	2 (7)	61 (190)	28 (89)	100 (313)
Unchecked	18 (31)	4 (6)	61 (103)	18 (30)	100 (170)
Untreated	18 (14)	6 (5)	57 (44)	8 (14)	100 (77)
Total	12 (82)	3 (22)	60 (400)	24 (160)	100 (664)
All reported[a]	12 (113)	3 (26)	61 (587)	25 (244)	100 (970)

(n): Number of subjects.

[a] Including subjects whose category of the cerebrovascular disease was reported, but information on hypertensive control before the onset was not provided.

Table 3 Mean age at onset of cerebrovascular disease for each category of disease and pattern of hypertensive control before onset.

Pattern of hypertensive control before onset	Category of cerebrovascular disease: Cerebral hemorrhage Age ±SE (n) (years old)	Subarachnoid hemorrhage Age ±SE (n) (years old)	Cerebral infarction Age ±SE (n) (years old)	Others Age ±SE (n) (years old)	Total Age ±SE (n) (years old)
Normotensive	65 ± 3.4 (9)	71 ±7.6 (4)	67 ±1.3 (53)	70 ± 3.1 (18)	68 ±1.2(84)
Promptly Treated	61 ± 2.0 (23)	55 ±4.4 (7)	68 ±0.8 (156)	69 ± 1.0 (62)	67 ±0.6(248)
Unchecked	62 ± 1.9 (29)	54 ±4.4 (4)	67 ±1.1 (90)	71 ± 2.6 (17)	66 ±0.9(140)
Untreated	58 ± 3.7 (12)	55 ±2.7 (5)	65 ±1.8 (41)	68 ± 3.7 (11)	64 ±1.5(69)
Total	62 ± 1.2 (73)	58 ±2.7(20)	67 ±0.6 (340)	69 ± 0.9(108)	67 ± 0.4(541)
All reported[a]	62 (98)	58 (24)	68 (476)	69 (158)	67 (756)

(n) : Number of subjects.

SE : Standard error

By two-way analysis of variance : total effect: $p < 0.01$ (df = 15)

main effects by categories of disease: $p < 0.01$ (df = 3)

main effects by patterns of hypertinsive control: $p < 0.05$ (df = 3)

two-way interactions: not significant (df = 9)

[a] Including subjects whose age at onset was reported, but information on hypertensive control before the onset was not provided.

eases as a whole was 68 years for the normotensive group, 67 years for the promptly treated group, 66 years for the unchecked group, and 64 years for the untreated group. In each of the four categories of cerebrovascular diseases, the mean age at onset tended to be higher for the normotensive or promptly treated group than for the unchecked or untreated group. This trend was found to be significant by two-way analysis of variance. The mean age at onset for subjects with cerebral hemorrhage or infarction was three years higher for the promptly treated group than for the untreated group (Table 3).

The percentage of subjects who were bed-bound was 16% in the normotensive group and was 32% in the untreated group, while the percentage of subjects with almost no disability was 52% in the normotensive group and was 36% in the untreated group. The percentage of bed-bound was in the increasing order from normotensive, to promptly treated group, to unchecked, and to untreated groups. On the other hand, the corresponding figures for subjects with almost no disability was in virtually the same decreasing order. After adjusting with age and sex using logistic regression, odds ratio of bed-bound or chair-bound to house-bound or almost no disability for the untreated group compared to the normotensive group was 2.83 with 95% confidence intervals from 1.45 to 5.55 (Table 4). The odds ratio for the untreated group compared to the promptly treated group was 2.82 with confidence interval from 1.69 to 4.72.

Hemiplegia was most commonly observed for subjects in the untreated group, and was most uncommon for subjects in the normotensive group. The percentage for subjects who suffered from hemiplegia was in the same increasing order as for bed-bound patients. Sex and age adjusted odds ratio of those who had hemiplegia or quadriplegia to those who had no paralysis for the unchecked group and for the untreated group compared to the normotensive group were 1.78 (with confidence interval from 1.06 to 2.98) and 2.89 (with confidence interval from 1.52 to 5.47) respectively (Table 5). The odds ratio for the untreated group compared to the promptly treated group was 2.58 with 95% confidence interval from 1.52 to 4.38.

Another statistically significant relationship was observed between the patterns of rehabilitation therapy needed and of hypertensive control. Nearly 30% of the patients in the normotensive, promptly treated or unchecked groups needed regular rehabilitation therapy, while 40% in the untreated group needed the same therapy. Sex and age adjusted odds ratio of those who needed rehabilitation therapy to those who did not need for untreated group compared to normotensive group was 2.29 with 95% confidence interval from 1.23 to 4.27 (Table 6).

Table 4 Patients with cerebrovascular disease classified by degree of restriction in activities of daily living and pattern of hypertensive control before onset.

Pattern of hypertensive Control before onset	Degree of restriction in ADL Bed-bound % (n)	Chair-bound % (n)	House-bound % (n)	No disability % (n)	Total % (n)	Sex, age adjusted odds ratio[a]	95% Confidence Intervals
Normotensive	16 (15)	10 (9)	22 (21)	52 (49)	100 (94)	1.00	
Promptly Treated	18 (52)	8 (25)	21 (61)	53(159)	100(297)	1.05	0.61 - 1.80
Unchecked	21 (33)	14 (22)	23 (36)	43 (69)	100(160)	1.53	0.86 - 2.73
Untreated	32 (24)	16 (12)	15 (11)	36 (27)	100 (74)	2.83	1.45 - 5.55[b]
Total	20(124)	11 (68)	21(129)	49(304)	100(625)		
All reported[c]	18(157)	11 (96)	22(196)	50(446)	100(895)		

(n):Number of subjects.
[a] Dependent variable: 1 for bed-bound or chair-bound; 0 for house-bound or almost no disability.
Covariate: 1 for treated, unchecked or untreated; 0 for normotensive.
[b] $p<0.01$
[c] Including subjects whose degree of restriction was reported, but information on hypertensive control before the onset was not provided.

Table 5 Patients with cerebrovascular disease classified by types of paralysis of the extremities and pattern of hypertensive control before onset.

Pattern of hypertensive control before onset	Paralysis of extremitie Hemiplegia or quadriplegia % (n)	Without paralysis % (n)	Total % (n)	Sex, age adjusted odds ratio[a]	95% Confidence Intervals
Normotensive	44 (45)	56 (58)	100(103)	1.00	
Promptly Treated	48(150)	52(160)	100(310)	1.18	0.75 - 1.87
Unchecked	57 (96)	43 (72)	100(168)	1.78	1.06 - 2.98[b]
Untreated	71 (55)	29 (22)	100 (77)	2.89	1.52 - 5.47[c]
All	53(346)	47(312)	100(658)		
All reported[d]	50(476)	50(484)	100(960)		

(n) : Number of subjects.
[a] Dependent variable: 1 for hemiplegia or quadriplegia; 0 for without paralysis.
Covariate: 1 for treated, unchecked or untreated; 0 for normotensive.
[b] $p<0.05$
[c] $p<0.001$
[d] Including subjects whose paralysis of extremities was reported, but information on hypertensive control before the onset was not provided.

Table 6 Patients with cerebrovascular disease classified by need for rehabilitation therapy and pattern of hypertensive control before onset.

Pattern of hypertensive control	Need for rehabilitation therapy Regularly % (n)	Occasionally % (n)	No need % (n)	Total % (n)	Sex, age adjusted odds ratio[a]	95% Confidence Intervals
Normotensive	2 (29)	11 (11)	60 (61)	100(101)	1.00	
Promptly Treated	29 (92)	20 (62)	51 (160)	100(314)	1.39	0.88 - 2.20
Unchecked	30 (50)	19 (31)	51 (85)	100(166)	1.39	0.84 - 2.31
Untreated	40 (31)	21 (16)	40 (31)	100 (78)	2.29	1.23 - 4.27[b]
Total	31(202)	18(120)	51 (337)	100(659)		
All reported[c]	28(265)	17(167)	55 (529)	100(961)		

(n) Number of subjects.
[a] Dependent variable: 1 for regular or occasional need; 0 for no need.
Covariate: 1 for treated, unchecked or untreated; 0 for normotensive.
[b] $p<0.01$
[c] Including subjects whose need for rehabilitation therapy was reported, but information on hypertensive control before the onset was not provided.

Discussion

Fries[11] predicted in 1980 that the amount of disability can decrease as morbidity is compressed into a shorter time span between the increasing age at onset of disability and the fixed occurrence of death, so that the end of the period of adult vigor will come later than it used to. However, Schneider and Brody[12] wrote in 1983 that unless preventive measures are effective, there will be a burgeoning number of patients needing long-term care.

Among the main studies on preventive measures for cerebrovascular disease, the five-year findings of the Hypertension Detection and Follow-up Program in the United States published in 1979[13] showed that the systematic management of hypertension had a great potential to reduce mortality for the large numbers of people with high blood pressure in the population. A Medical Research Council Working Party in the United Kingdom[14] reported, in 1985, that if 850 mildly hypertensive patients take anti-hypertensive drugs for one year, the equivalent of about one stroke will be prevented. Bonita and Beaglehole[15] in New Zealand estimated, in 1986, that treatment of hypertension accounted for about 10% of the observed reduction in deaths from stroke in the country. Life-table analysis in a Swedish study[16] showed, in 1991, that patients treated before strokes had lower morbidity and mortality from the stroke than those who were not treated.

Whisnant et al.[17] mentioned in the Report of the Joint Committee for Stroke Facilities, in 1972, that "information is lacking as to whether strokes can be prevented by treating asymptomatic hypertensive patients discovered at casual examination or in a population survey". The results discussed previously showed that anti-hypertensive treatment tended to improve the natural history of stroke. However, these studies did not address the question of Whisnant on the effects of treatment of hypertension discovered during casual examination. Rabkin et al.[18] stated in 1978 as the result of their survey on blood pressure before stroke and survival after the event, that systolic blood pressure and its 5-year change were each significant predictors of short-term mortality, while McEwan et al.[19] reported in 1990 that their screening trial, which included measurement of blood pressure, provided no evidence that physical problems were lessened or activities of daily living rendered easier in the test group compared with the control group.

Recently, findings have been published indicating that treatment of hypertension has hardly contributed to the decline in stroke mortality. Klag et al.[20] reported in 1989 that treatment of hypertension may not be the principal reason for the decline in stroke mortality. Bonita et al.[21] suggested in 1990 that "before devoting even more resources to a high-risk approach, we need a better understanding of the reasons for recent trends in the change in stroke mortality, particularly in countries with increasing stroke mortality rates", although Tanaka et al.[22] proposed, in 1982, mean arterial pressure as the best predictive measure, and Shimamoto et al.[23] revealed, in 1989, a significant and independent relation of systolic blood pressure to hemorrhage, from their survey done in a rural area where stroke mortality used to be comparatively high. Casper et al.[22] concluded, in 1992, that additional studies should address the association between declining stroke mortality and trends in socioeconomic resources, dietary patterns, and cigarette smoking.

Although our study was not done according to the case-control design, our method had two distinct advantages. One was that we could have approached all the patients with cerebrovascular disease who received treatment in a certain city, although the samples were not randomly selected and limited to those who were alive. Thus the subjects represented a fairly large scale of population observed over a given time period, with the cooperation of all doctors and facilities in the City. Another was that we could have obtained information on the pattern of hypertensive control before the onset of the disease from the patients, independently from information on the conditions at onset of the disease and the need for rehabilitation therapy obtained from the physicians.

The results suggests that for those who had received prompt treatment after early detection of hypertension by a casual blood pressure measurement performed during health check-ups, the disease was less severe and the onset of the disease delayed.

The percentage of our subjects with cerebrovascular diseases who received prompt treatment after detection of hypertension was 47%. In contrast, the percentage of those who were "unchecked" was 26% and that of those who had hypertension "detected but untreated" was 12%. According to Ozawa et al.[25] who analyzed a Japanese National Survey of Circulatory Disorders in 1980 of 10,897 residents aged 30 or over, 2,183persons (20.0%) were hypertensive; of this total, 900 persons (8.3%) were "unchecked" and 560 persons (5.1%) had hypertension that was "detected but untreated". The corresponding figures for our subjects were higher. This might suggest the tendency of prospective stroke patients to make less use of health check-ups or prompt treatment of detected hypertension than others.

The city of N. is an ordinary Japanese city in terms of the promotion of health check-up programs for the residents. Blood pressure check-ups are carried out in order to enhance the possibility for early detection of hypertension in work places and communities throughout Japan. The mean age at onset was three years higher for those treated than for those untreated after hypertension was detected during a check-up. Thus, if the proportion of people who had "detected and promptly treated" hypertension is estimated to be almost half of those aged 50 or over with cerebrovascular disease, it can be assumed that the blood pressure check-up programs may have contributed to an overall reduction in severity for nearly half of the patients with cerebrovascular disease.

We would thus like to respond to Whisnant et al.[17] by stating that strokes can be mitigated by treating asymptomatic hypertensive patients. Rowe[26] emphasized that if health promotion and disease-prevention strategies compress morbidity into the very end of the life span, the increased life span of the very old may actually result in a more dramatic increase in the need for health care services. Tatara et al.[27] showed, from a survey for 4,244 house-bound patients by the Osaka Prefectural Medical Association, that cerebrovascular disease was the most common reason to become house-bound in all ages , particularly in their 60s (73% for men and 48% for women) and 70s (66% and 41%, respectively). In Japan, facing a rapid aging of the population combined with a high stroke morbidity, we believe it is crucial to promote services for early detection and providing prompt treatment of hypertension in view of the compression of stroke morbidity. Shimamoto et al.[28] and Okamura[29] suggested, in 1994, that hypertensive control could decrease not only mortality but also the need for nursing care after stroke, in their result ofa long-term survey of population in rural districts in Japan. Our study supported these findings through an investigation in an urban society.

In conclusion, patterns of hypertensive control after blood pressure check-ups can affect the severity, the age at onset, and the type of cerebrovascular disease. Consequently, in Japan, nearly half of the patients with cerebrovascular diseases, who have check-ups which result in early detection of hypertension and receive prompt treatment, may benefited from such improvements in the outcome.

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