RESEARCH COMMUNICATION

Analysis of the Standardization and Centralization for Cancer Treatment in Nagasaki Prefecture

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Abstract

In medical care systems for cancer, it is important to consider the issues of standardization and centralization. In this study, we employed the Nagasaki Cancer Registry, which has a high registry rate, to investigate standardization and centralization for five major cancers, in addition to childhood malignancies (which are often rare types). Subjects were patients diagnosed with cancer and registered in the Nagasaki Cancer Registry between 1985 and 2004. For standardization, we calculated a Preference Index and five-year survival rate, and for centralization we investigated Pareto curves and Gini coefficients as well as the annual average number of cases per hospital. Results suggested that patients migrate to medical service areas different from where they reside in order to receive treatment at facilities thought to have a better record of treatment. In addition, while the number of patients and treatment facilities for childhood cancer was decreasing due to a decline in the number of children, the centralized tendency differed for the 12 diagnoses assessed. By conducting analyses based on population-based cancer registries using the evaluation methods employed in this study, it should be possible to investigate patients' migrant patterns, as well as to develop systems for providing medical care in secondary medical service areas.

Keywords: Cancer treatment - cancer registry - standardization - centralization

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Introduction

In medical care systems for cancer, it is important to consider standardization and centralization. Standardization means equity in access and high-quality cancer treatment of the visiting hospital anywhere in the country (Ministry of Health, Labour and Welfare, 2010). This is considered important for those cancers that afflict a large number of people. Centralization, on the other hand, means congregating the similar patients into the specific hospital, and integrating technologies. This is considered important for improving the survival rate of patients with rare cancers (Stiller CA, 1994).

A previous study that used resources from the Osaka Cancer Registry suggested the possibility of regional differences in systems for providing treatment for the five major cancers (Shiki et al., 2008). It was also reported that centralization was not observed for treatment of childhood cancer, known to be a rare cancer (Tsutsui et al., 2009). Regret to say, there are no reports of similar investigations in other regions. In addition, investigations have been limited to standardization in the five major cancers (Shiki et al., 2008), and to centralization in childhood cancer (Tsutsui et al., 2009). There are no reports which both standardization and centralization were investigated for each.

In this study, we therefore sought to analyze standardization and centralization in Nagasaki Prefecture, which possesses the highest ratio of hospitals per population in the nation. Nagasaki Prefecture is characteristic in that it possesses remote islands, and differs greatly from Osaka Prefecture. Regarding to its cancer registry, it is one of the population-based registries having longest tradition and highest registration rate (Ministry of Health, Labour and Welfare, 2007).

Materials and Methods

In this study, subjects were patients diagnosed with cancer and registered in the Nagasaki Cancer Registry between 1985 and 2004. We then excluded patients who had registered by death certificate only, those who had registered by recurrent cancer, those who had registered by multiple cancer, and carcinoma in situ. The final number of subjects of the five major cancers was 54900 (stomach 19365, colon 15818, lung 7291, liver 7291, breast 7350). Subjects of childhood cancer were 727 patients under the age of 15.

As the index for standardization, we proposed Preference Index (PI), which means proportion of the patients treated by the hospitals in the same residential area. We calculated PI by the five major cancers and

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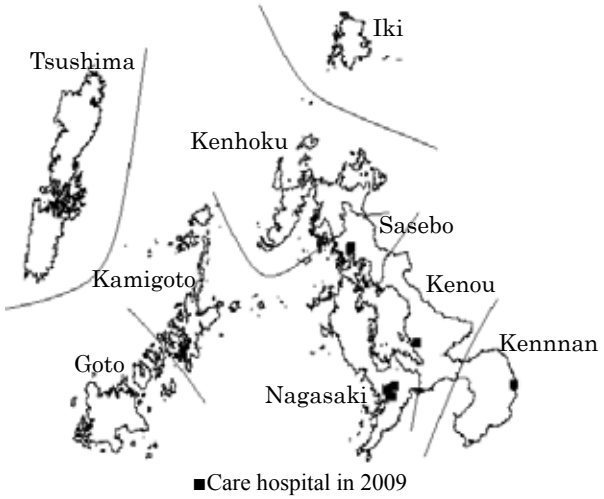

Figure 1. Secondary Medical Service Area in Nagasaki Prefecture

childhood cancer every secondary medical service areas (Figure 1) (Nagasaki Prefecture Official Homepage, 2010). In addition to, we calculated proportion of the patients treated by the hospitals in other prefectures (PI for other prefecture hospitals). The patients were then divided by the diagnosed year in order to investigate the changes of patients' migrant patterns by secondary medical service area. The patients with the five major cancers were divided into three period groups (1985-1991, 1992-1998 and 1999-2004), and those with childhood cancer were divided into two period groups (1985-1994 and 1995-2004).

Furthermore, we analyzed five-year survival rates of patients with the five major cancers for patient's residential district and those for hospital's location district. The number of patients with childhood cancer was so small therefore we did not analyze five-year survival rates of patients with childhood cancer.

As the index for centralization, we counted up the cumulative frequency of hospitals when the cumulative frequency of patients was upper 50, 70 and 100%, and investigated year-to-year changes. In this analysis, we excluded patients who did not specify treating hospital code. Subjects of the five major cancers were 53256 (stomach 19365, colon 15818, lung 7291, liver 7291, breast 7350), and those of childhood cancer were 583. In addition to, we used a Pareto analysis and Gini coefficient.

Furthermore, we investigated the annual average number of cases per hospital that treated 90% of all patients, which is often employed in previous studies (Ablett and Pinkerton, 2003). We calculated and examined change of this by sex for five major cancers excluded breast, and for all childhood cancer cases and the 12 diagnoses of the International Classification of Childhood Cancer (ICCC).

Results

During the object period, the number of patients with stomach or liver cancer decreased, and that with colon, lung or breast cancer increased. The increase rate of patients with lung cancer was particularly high. The number of patients with lung cancer increased from 108 in 1985 to 558 in 2004, and the increase rate was 5.2. The increase of number of patients with colon cancer was the largest of the five major cancers. It increased from 453 to 1017, and the increase rate was 2.2.

The number of children, on the other hand, decreased from 360 to 140 thousands during 20-year period. The number of patients with childhood cancer changed year by year, and that decreased from 41 in 1995 to 16 in 2004.

Nagasaki Prefecture is divided into nine secondary medical service areas, and has one prefectural care hospital and five regional care hospitals (Nagasaki Prefectural Government, 2010). These six care hospitals are located in Nagasaki, Sasebo, Omura and Shimabara City. One of those in Nagasaki City and that in Shimabara City were defined as care hospitals on January 31, 2007. It is therefore thought that care hospitals were located in Nagasaki, Kenou and Sasebo medical service areas during the object period. We conducted this study by considering this situation.

During the object period, the highest PI (over 90%) of the five major cancers was shown in Nagasaki medical service area for every sexes and periods. The high PI was also shown in Kenou and Sasebo medical service areas. The lowest PI (average 26%), on the other hand, was shown in Iki medical service area. By site, the high PI was shown for colon cancer (average 67%) and stomach cancer (average 66%). The low PI, on the other hand, was shown for lung cancer (average 46%). The PI for lung cancer in Iki was 12%. Difference between medical service areas in PI for childhood cancer was big (Nagasaki 95%, Iki 0%). In addition to, it was clarified that 99% of patients with childhood cancer in Nagasaki Prefecture receive treatment in either one of the three medical service areas with care hospitals.

The low PI for other prefecture hospitals (1.0-2.2%) was shown in medical service areas that had the high PI. The high PI for other prefecture hospitals was shown in Iki (71.5%), and Tsushima (34.1%). PI for other prefecture hospitals for the five major cancers in Nagasaki Prefecture decreased from 1985-1991 to 1999-2004. That for childhood cancer, on the other hand, increased.

Five-year survival rates for hospital's location district in each secondary medical service area were high in three medical service areas with care hospitals, and those were low in Iki and Tsushima medical service areas which are remote islands. Regret to say, differences in five-year survival rates for patient's residential district were smaller compared to those for hospital's location district.

The number of medical facilities that treat patients with stomach cancer decreased for both males and females. Clear tendency was not shown for other major cancers. Figure 2 shows the cumulative frequency of hospitals of childhood cancer during 20-year period. The hospitals treating upper 50% of patients retained less than one, and those treating upper 75% ranged one to three, and those treating all patients decreased from nine in 1994 to four in 2004.

From the viewpoint of the Pareto curve and the Gini coefficient, centralized tendency was suggested for lung cancer for females and other four major cancers. The

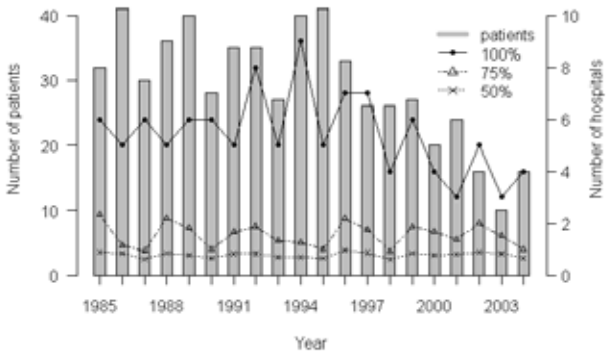

Figure 2. Change in the Number of Childhood Cancer Patients and Medical Institutions

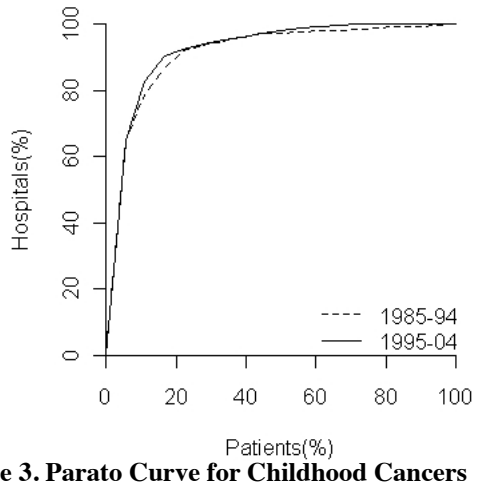

Figure 3. Parato Curve for Childhood Cancers

Pareto curve of all childhood cancer cases in 1995-2004 was upper left than that in 1985-1998 (Figure 3). The Gini coefficient increased from 0.823 in 1985-1994 to 0.843 in 1995-2004. The above findings suggest that childhood cancer is centralized tendency.

The annual average number of cases per hospital increased in both males and females of the five major cancers. Particularly that for lung cancer dramatically increased (male: from 7.3 to 20.3, female: from 2.8 to 11.7). The highest annual average number in 1999-2004 was showed breast cancer (30.7). That for all childhood cancer cases increased from 8.54 to 10.10. By the 12 diagnoses of the ICCC, the annual average number for six diagnosed groups containing hepatic tumors, which was showed the lowest incidence rate (1.5 per one million), increased.

Discussion

PI was found to be high in medical survive areas with care hospitals, and low in remote islands, while PI for other prefecture hospitals showed the opposite trend. Thus, a high proportion of patients in Iki and Tsushima received treatment at medical facilities located other prefectures. These findings show that travel convenience, as reflected in the ease of commuting to medical facilities in other prefectures rather than receiving treatment in medical service areas of Nagasaki Prefecture on the main island of Kyushu, influences patients in remote islands. Furthermore, the large difference in PI between medical service areas with care hospitals and those on remote islands, particularly for lung and childhood cancers, suggests centralization in the case of cancers with high mortality rates or in rare cancers.

In addition, because differences in five-year survival rates for patient's residential district were smaller compared to those for hospital's location district in each medical service area, we considered scenarios that included patients migration to medical service areas to receive treatment at medical facilities thought to have better treatment records; and patients receiving treatment at hospitals in other medical service areas based on doctors' referrals. A similar situation had previously been observed in Osaka (Shiki et al., 2008). A decreasing trend was observed in PI for other prefecture hospitals for the five major cancers, and it is likely that progress is being made to prepare a medical system for treating high-prevalence cancers within Nagasaki Prefecture. The above findings suggest that it may be possible to use the patients' migrant patterns such as PI and PI for other prefecture hospitals, as evaluative indices of standardization.

With childhood cancer, centralization was indicated in medical service areas with care hospitals. When determining the number of medical facilities that treat childhood cancer, debate may arise as to whether this number reflects the centralization of treatment, since the number of treatment facilities is dependant on the numbers of childhood cancer patients, decreasing in concert with a decline in child population. In this case, we think that it is necessary to study year-to-year changes in the number of medical facilities treating childhood cancer for each medical service area as an index of centralization at the medical service area level. In addition, it is important to consider movements in PI for other prefecture hospitals and investigate treatment areas coordinating with other prefectures.

It is thought that Pareto curve and Gini coefficient are less likely to be influenced by fluctuations in patient numbers than by the number of medical facilities treating childhood cancers. Regrettably, Gini coefficient is thought to contain downward bias when the number of subjects is 50 or lower (Lerman and Yitzhaki, 1989). Of the 12 diagnoses, the number of childhood cancer patients was 50 or lower in 11 groups, excluding leukemia. Evaluating centralization solely with Gini coefficient is therefore inappropriate. For this reason, we investigated all childhood cancers grouped together, and found a suggested centralized tendency in the five major cancers and childhood cancer. Calculations of the annual average number of cases per hospital for childhood cancers performed separately for the 12 diagnoses suggested centralized tendency for cancers such as hepatic tumors. So it is possible that even childhood cancer, particularly those that are rare, will show centralization.

There was a marked increase in the annual average number of lung cancer cases per hospital in both males and females. We believe this is related to the increase in afflicted numbers, high mortality rates, and the potential migrant of patients across medical service areas for the purpose of receiving treatment, as indicated by low PI for lung cancer in recent years. These observations

well suggested centralization for cancers that are rare or difficult to treat. It is therefore likely that patients began gathering in specified medical facilities as a result of doctors' referrals, although the referral system among medical facilities cannot be determined from cancer registry resources. In the future, investigations of centralization through analysis of Pareto curves and Gini coefficients together with cancer regional medical care systems and migrate patterns stratified by disease stage, should enable more detailed discussion and analysis.

Implementation of standardization and centralization results in benefits such as the ability to receive high-quality medical care at any location, or improved survival rates due to integration of technologies. It is, however, also possible that centralization may generate problems such increasing the burden of migrant to alternate locations to receive treatment. In either case, in order to establish policies on systems to provide cancer treatment, it is necessary to accurately understand the current treatment situation. In this study, we investigated evaluation methods of standardization and centralization, and demonstrated their potential utility.

Acknowledgments

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