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Title	Efficiency of Local Stroke Center Network in Northern District of Japan : A Survey Under the Auspices of Department of Health and Welfare, Hokkaido Prefectural Government. [an abstract of dissertation and a summary of dissertation review]
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Description	配架番号 : 2177
Degree Grantor	北海道大学
Degree Name	博士(医学)
Dissertation Number	甲第11930号
Issue Date	2015-06-30
Doc URL	https://hdl.handle.net/2115/59664
Rights(URL)	https://creativecommons.org/licenses/by-nc-sa/2.1/jp/
Type	doctoral thesis
File Information	Kousuke_Oonishi_abstract.pdf, 論文内容の要旨



学位論文内容の要旨

博士の専攻分野の名称 博士 (医 学)

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学 位 論 文 題 名

Efficiency of Local Stroke Center Network in Northern District of Japan: A Survey
Under the Auspices of Department of Health and Welfare, Hokkaido Prefectural
Government.

(北日本の地域脳卒中センターネットワークの効率性：
北海道庁保健福祉部後援の調査)

BACKGROUND AND PURPOSE

In Japan, stroke mortality has decreased due to advances of its prevention through treatment. To improve acute stroke care, it was recommended that 2 levels of stroke centers be established in the United States: a primary stroke center (PSC) and a comprehensive stroke center (CSC). Formation of stroke centers began in 2003 by the Brain Attack Coalition (BAC), an expert panel to promote communication between medical organizations. More than 1000 stroke centers are certified. PSCs provide initial acute stroke treatment, neurosurgical service if available. Possible strokes are transported to the nearest PSC or CSC and then be transferred to CSC if necessary. The CSCs require intensive care unit and neurosurgical services. In 2011, stroke centers decreased risk of death after stroke. In Japan, stroke patients are treated in stroke centers equipped with neuroimaging and neurosurgery. We investigated all 78 stroke hospitals in Hokkaido, of which 58 are equivalent to CSC. The Ministry of Health, Labor, and Welfare (MHLW) of Japan puts emphasis on the control of four major diseases and five medical services in Medical Service Law in 2007. To evaluate the current state, each prefecture initiated survey of four diseases and five medical services. We focused on the pre-diagnosis time intervals and interhospital transfer, and showed whether living in areas without CSC is related to high interhospital transfer rate.

METHODS

The study was carried out during the two weeks of each January and July from July 2009 to January 2011, a total of four 2-week sessions. All stroke patients who were admitted to the 78 stroke hospitals, within 7 days after onset. Approval for this study was obtained by the Hokkaido Cardio-cerebrovascular Disease Subcommittee, which is a multidisciplinary committee including Hokkaido Prefectural Government, Hokkaido Medical Association, all three academic hospitals. All efforts were made to protect patients' confidentiality. In Japan, residents are covered by public health insurances, medical services are provided at a low price, and it is customary to transport patients with acute condition to emergency facilities and EMS is available for free, hence almost all stroke patients are captured. Questionnaire consisted of 31 items as follows: time of onset, emergency call, EMS arrival on-scene, hospital arrival, and diagnosis; mode of transport; gender; age; onset place; witness status; stroke subtype. In Japan, health service areas (HSAs) are organized into primary, secondary, and tertiary levels. Hokkaido prefecture is divided into 179 primary health service areas (PHSAs) to match the administrative boundaries of cities. Hokkaido has 21 secondary health service areas (SHSAs) which were divided according to 14 subprefectures' boundaries and medical resources. The SHSAs mainly focus on acute intervention and stabilization. Tertiary health service areas (THSAs) provide advanced medical care and Hokkaido contain six THSAs. Emergency facilities are classified into three levels: primary, secondary, and tertiary. Emergency patients of good condition are transferred to emergency hospitals. In Hokkaido, there are 11 critical care centers that provide care for severe cases, of which two are advanced critical care centers that treat complex types of stroke, severe burns, and major trauma. To classify 78 stroke hospitals under survey, we applied the

term “CSC” to match the definition of the BAC. We divided 78 stroke hospitals into two groups: CSCs and non-CSCs. Then we divided 21 SHSAs into two groups according to the presence or absence of CSC. Due to the small number of patients in 6 rural SHSAs lacking a CSC, these 6 SHSAs were combined into one group. The remaining 15 SHSAs with CSCs were also combined into one group.

Median values were mainly analyzed because the skewed distribution of the data made the medians more appropriate. Categorical data are presented as percentages unless indicated otherwise. Continuous data are presented as mean (SD) or median (IQR). The homogeneity of variance assumption was tested using Levene test. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to examine the normality of distribution. For comparison of continuous variables, Student's or Welch's t tests was used. The Mann-Whitney test was used to compare medians. ANOVA or Kruskal-Wallis tests were used to compare mean and median differences. The Chi-square tests were used for between-group comparisons. The extended Fisher's exact test was used to compare proportions in categorical characteristics.

RESULTS

Mean age of all stroke patients was 72.1 years. There was a significant difference in mean age among 5 stroke subtypes ($P=0.000$). There were 1317 patients (50.8%) who activated EMS. The median time of onset-to-EMS activation was 30 min, from EMS call to arrival on scene was 6 min. The mean time from EMS arrival on-scene to hospital was 26 min. There were 671 patients who underwent at least one interhospital transfer. The median time from onset to hospital arrival was 1 hr 6 min for EMS users, and 6 hr 32 min for non-EMS users. There were statistically significant differences among 6 THSAs in onset-to-EMS activation time ($P=0.024$), EMS activation to EMS arrival on-scene time ($P=0.001$), EMS arrival on-scene to hospital arrival time ($P=0.000$), hospital arrival to diagnosis time ($P=0.000$), onset to diagnosis time ($P=0.033$), interhospital transfer rate ($P=0.000$), but there was no significant difference by the EMS use rate ($P=0.135$).

There was a statistically significant difference among 6 THSAs in interhospital transfer rate ($P<0.001$). Among 6 THSAs, 18.0% of patients underwent interhospital transfer in Douou THSA, while 49.4% underwent interhospital transfer in Kushiro THSA. Of the patients from 6 rural SHSAs without CSCs, 79% underwent interhospital transfer. This figure was higher than that of the patients from 15 SHSAs with CSCs, in which 23% underwent interhospital transfer ($P<0.001$). In Hokkaido, 93.4% of the population (5.2 million people) reside in SHSAs with a CSC which provides neurosurgical coverage.

DISCUSSION

All the 21 SHSAs contain at least one stroke center, but 6 of the 21 SHSAs lack a CSC, and patients of these 6 areas tend to undergo interhospital transfer. It is difficult to provide adequate neurosurgical care widely, especially in rural areas. It is recommended that most acute stroke patients be initially stabilized and provided with emergency care in PSCs. Such patients would then be transferred to CSCs if necessary. In our survey, 25.9% of patients underwent interhospital transfer. Comparing 6 THSAs, only central Hokkaido THSA achieved low interhospital transfer rate.

The median interhospital transfer time was 30 minutes. The median transfer time from intervening hospital to receiving hospital was 20 minutes in SHSAs with CSCs, but it reaches 78 minutes in SHSAs without CSCs. Mean interhospital transfer rate is 78.5% in all SHSAs without CSC, whereas only 23.8% of patients underwent interhospital transfer in SHSAs with CSC. Further education of rural caregivers and remote support from tertiary stroke centers to improve suboptimal stroke care in rural hospital is recommended. Other solutions are widespread use of helicopter, telemedicine, diagnosis and initiation of treatment during transport, formation of Acute Stroke-Ready Hospital which provides initial diagnostic services, stabilization, emergency care, and treatment.

CONCLUSION

Interhospital transfer rate was greater in rural areas compared with that in non-rural areas. About 360 thousand people (6.6% of the Hokkaido population) reside in SHSAs without CSC. This study revealed disparities in acute stroke care among different SHSAs in Hokkaido.