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Original Article

Association between population changes and the number of endovascular thrombectomies

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ABSTRACT

Background: Randomized controlled trials have demonstrated the efficacy of mechanical thrombectomy (MT) for acute ischemic stroke. However, few studies indicate an association between the number of mechanical thrombectomies and population changes. We aimed to clarify the association between population changes and the number of mechanical thrombectomies for proper allocation of limited medical resources.

Methods: We retrospectively analyzed data from 162 patients who underwent MT for large vessel occlusion at our hospitals and compared the number of mechanical thrombectomies per 100,000 person/year to population changes in five regions covered by our hospitals within 2015–2016 and 2017–2019. We performed a simple linear regression analysis to determine the association between population changes and the number of mechanical thrombectomies.

Results: Overall, the number of mechanical thrombectomies increased from 15.1 to 19. However, a significant decrease was noted in Toya Lake and Sobetsu/Toyoura. Furthermore, there was a significant negative linear correlation between the overall population reduction rate and the number of mechanical thrombectomies and a positive linear correlation between the increased proportion of the population aged >65 years and the number of mechanical thrombectomies.

Conclusion: The number of mechanical thrombectomies may decrease in areas where the overall population reduction rate exceeds 8% or the increased rate of the population aged >65 years is <4%. However, it is necessary to continue establishing a system for MT in areas that have yet to reach these levels.

Keywords: Acute ischemic stroke, Aging population, Large vessel occlusion, Mechanical thrombectomy, Population changes

INTRODUCTION

Several randomized controlled trials, including MR CLEAN, ESCAPE, EXTEND-IA, SWIFT PRIME, and REVASCAT, have demonstrated the efficacy of mechanical thrombectomy (MT) for acute ischemic strokes (AIS) from large vessel occlusions (LVO).[3,4,6,8,15] The DAWN and DEFUSE3 trials have expanded the duration of MT for LVO.[2,12] The incidence rate of AIS increases with age; therefore, with the increasing aging population, there is an expected increase in the number of patients eligible for MT.[5,9,16,18] There has been an increase in the annual number of MTs, which

Table 1: Compositions and changes of population in the two periods.

Regions	First period (2015–2016)		Second period (2017–2019)		First–Second period	
	Overall population	Age >65 years	Overall population	Age >65 years	Overall population	Age >65 years
Muroran	91276	29551	84405	31172	−6871	1621
Noboribetsu	50889	15585	48395	17138	−2494	1553
Date	36195	11522	34365	12532	−1830	1010
Toya lake	9783	3533	8841	3615	−942	82
Sobetsu/Toyoura	7120	2424	6504	2456	−616	32
Total	195263	62615	182510	66913	−12753	4298

will continue.[1,14] Theoretically, the total number of patients with LVO eligible for MT reaches 10–20/100,000 person/year; however, in real-world settings, only a limited number of patients undergo MT.[14] Furthermore, regional differences exist in the ratio of patients undergoing MT, such as between urban and rural areas.[10] Therefore, there is a need to continue establishing a system for MT.[14] We aimed to clarify the cause of regional disparities in the number of MTs performed by indicating an association between population change and the number of MTs to inform the proper allocation of limited medical resources.

MATERIALS AND METHODS

We retrospectively analyzed the Japanese Diagnosis Procedure Combination (DPC) data of all 162 patients who underwent MT for LVO at our hospitals between 2015 and 2019. The DPC data include national administrative hospital discharge data that describe detailed clinical information used by various clinical studies.[11,13,19] Two hospitals are the only stroke centers with three qualified physicians who can perform MT and cover all LVO patients in five regions: Muroran City, Noboribetsu City, Date City, Toya Lake Town, and Sobetsu/Toyoura Town. We compared the number of MTs per 100,000 persons/year with population changes in the five regions in 2015–2016 and 2017–2019. Data on the population were based on Japanese government data. We performed a simple linear regression analysis to analyze the association between population changes and the number of MTs. We utilized GraphPad Prism (version 8.0; GraphPad Prism Software Inc., San Diego, CA, USA) for statistical analysis. This study was approved by the in-hospital ethical board, and written informed consent was obtained from the patients or their families.

RESULTS

The entire region's population decreased, and the population aged >65 increased [Table 1]. MTs per 100,000 persons/year increased from 15.1 to 19.5. However, in Toya Lake and Sobetsu/Toyoura towns, the MTs per 100,000 person-years decreased from 15.3 to 7.5 and 14.0 to 10.3, respectively [Table 2]. The overall population reduction rate was 6.5%; furthermore, the overall increase in the population aged >65 years was 6.8%. The towns of Toya Lake and Sobetsu/Toyoura showed a higher overall population reduction rate (9.6% and 8.7%, respectively) and a lower increase rate in the population aged >65 years (2.3% and 1.3%) than did the other regions [Table 3]. Linear regression analysis revealed a significant negative linear correlation between the overall population reduction rate and the number of MTs (adjusted $R^2 = 0.81$, $P = 0.03$) [Figure 1]. In addition, the association between the increase rate in the population aged >65 years and the number of MTs showed a positive linear trend (adjusted $R^2 = 0.74$, $P = 0.06$) [Figure 2].

Table 2: Changes in the number of MTs per 100,000 person-year between the two periods in the five regions.

Regions	First period (2015–2016)	Second period (2017–2019)
Muroran	16.43	20.14
Noboribetsu	16.70	20.66
Date	9.67	16.50
Toya lake	15.33	7.58
Sobetsu/Toyoura	14.04	10.30
Total	15.11	18.79

MT: Mechanical thrombectomy

DISCUSSION

We observed an association between population changes and the number of MTs. A previous study reported regional differences in the proportion of performed MTs, consistent with our findings.[10] Based on our findings, the number of MTs performed is expected to decrease in regions where the overall population reduction rate exceeded 8% [Figure 1] or where the rate of the population of people aged >65 years is not surpassing <4% [Figure 2]. Therefore, it is necessary to continue establishing a system for MT in most areas that have yet to reach these levels of the overall population reduction rate and an increasing rate for the population aged >65 years.

Another predictive factor for the number of MTs is the current number of MTs per 100,000 persons/year. Theoretically, the total number of patients with LVO eligible for MT is

Table 3: Changes in population and the number of MTs in the two periods in the five regions.

Regions	Overall population reduction rate* (%)	Increasing rate of the population aged >65 years* (%)	Number of MTs per 100,000 person/year**
Muroran	7.50	5.48	3.71
Noboribetsu	4.90	9.96	3.96
Date	5.10	8.77	6.83
Toya lake	9.60	2.30	−7.75
Sobetsu/Toyoura	8.70	1.32	−3.74
Total	6.50	6.86	3.69

*2nd-1st/1st, **2nd-1st. MT: Mechanical thrombectomy

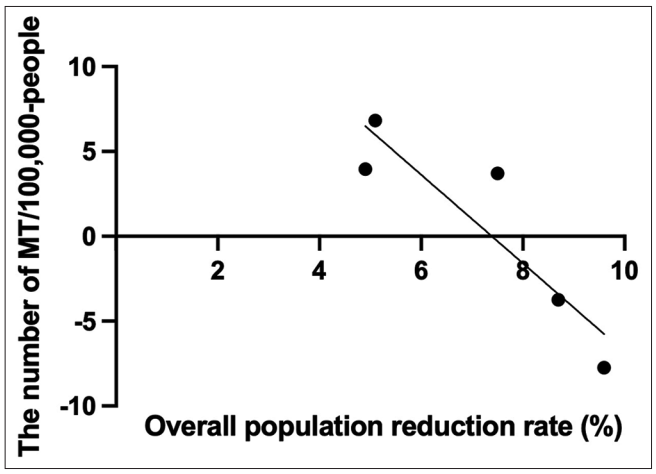

Figure 1: Association between the number of MTs and the overall population reduction rate. Adjusted R^2 = 0.81, P = 0.03, MT: Mechanical thrombectomy.

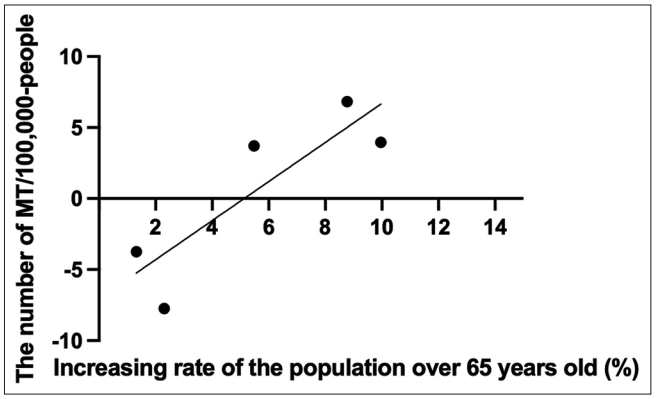

Figure 2: Association between the number of MTs and the increasing rate of the population over 65 years old. Adjusted R^2 = 0.74, P= 0.06, MT: Mechanical thrombectomy.

10–20/100,000 person-years.[14] In our study, the number of MTs performed in the five regions during the second period was 18.79/100,000 person-years [Table 2], consistent with the previous theoretical report, and indicates that our hospitals have adequate resources for providing MT. Our hospitals have covered almost all patients with ischemic stroke due to LVO who need to undergo MT in five regions. Therefore, considering our results, in our regions, the number of MTs is expected to increase until it reaches 20/100,000 person-years. Regardless of the population changes, increasing the number of MTs performed in areas that have not reached 10–20 MTs/100,000 person-years.

Few studies have indicated an association between population changes and the number of MTs. Therefore, it is not easy to compare our results to other regions. However, the population will decline with an inverted pyramid age distribution in all countries except Sub-Saharan Africa, North Africa, and the Middle East.[17] Specifically, 23 countries will be a population reduction rate of ≥50%.[17] The population reduction rate will reach 25–50% in 34 countries.[17] Our study region has one of the highest decreasing rates of the overall population and an increasing rate in the population aged >65 years old, which is higher than the Japanese national average.[7] Therefore, investigating our regions helps predict the number of MTs in the future in other regions and countries for the proper allocation of limited medical resources.

Limitations

This study has several limitations. First, it was a retrospective, two-center, and small-scale study, limiting the statistical strength of our findings. Second, the observation period is short because our hospitals started MTs in 2015. Third, the number of MTs might have increased by promoting MT therapy during the second period. In addition, the domestic guidelines for performing MT have changed based on the results of the DAWN and DEFUSE3 trials in 2018, which may have influenced the number of MTs performed during the second period.[2,12]

CONCLUSION

We observed an association between the population changes and the number of MTs. Our findings suggested that the number of MTs performed may decrease in areas where the overall population reduction rate exceeds 8% or the increase rate of the population aged >65 years is <4%. Based on these

results, it is necessary to continue establishing a system for MT in most areas that have yet to reach these levels.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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