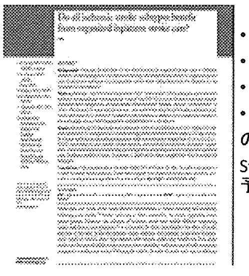
医療機関の質ーどんなことをしているか？

Organized Care Index（OCI）



- 脳卒中医療の質の評価指標
- ストロークチームによる評価
- SCUへの入院
- 脳卒中リハビリ

の3項目の点数の合計で評価します

Strokeのサブタイプ、年齢によらず予後と相関します

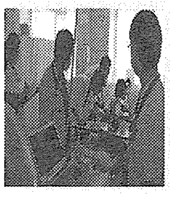
(Stroke 2008;39:2522–2530.)

脳卒中専門病棟での専門家チームによる治療 SCU(stroke care unit)

- 全身管理の徹底
- 呼吸管理　低酸素血症回避
- 血圧管理　血圧効果対策
- 水・電解質バランス保持
- 感染症予防

- 脳卒中ケアユニット入院医療管理料の施設基準
- (1) 病院の一般病棟の治療室を単位として行うものであること。
- (2) 当該治療室の病床数は、三十床以下であること。
- (3) 脳卒中ケアユニット入院医療管理を行うにつき必要な医師が常時配置されていること。
- (4) 当該治療室における看護師の数は、常時、当該治療室の入院患者の数が三又はその端数を増すごと
- に一以上であること。
- (5) 当該治療室において、常勤の理学療法士又は作業療法士が一名以上配置されていること。
- (6) 脳梗塞、脳出血及びくも膜下出血の患者を概ね八割以上入院させる治療室であること。
- (7) 脳卒中ケアユニット入院医療管理を行うにつき十分な専用施設を有していること。
- (8) 脳卒中ケアユニット入院医療管理を行うにつき必要な器械・器具を有していること。

ストロークチームによる評価

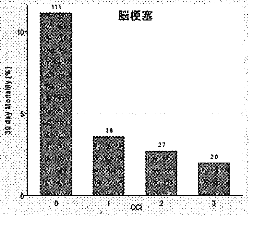


- 脳卒中の治療・ケアにあたって,
- 医師,
- 看護師
- 専門看護師（看護師の上級資格の1つであり,脳卒中治療・ケアに対して豊富な知識と経験を持つ看護師）
- 言語聴覚士（SLT）
- 作業療法士（OT）
- 理学療法士（PT）な
- どの様々な専門職種からなるストロークチームによる介入が有効とされています

脳卒中のリハビリ

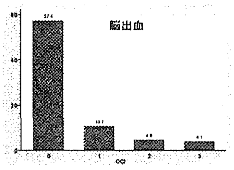
- 重度～中等度麻痺の場合、以前の健常な状態まで機能が回復することは難しいでしょう。
- しかし、リハビリでは片麻痺があるなりの動作方法を学習することで、再び歩いてトイレに行けたり、自分で着替えたり、お風呂に入ったりできるようになるかもしれません。
- また、リハビリを行った入院患者のおよそ6割は、装具などを用いて歩行が可能となります。

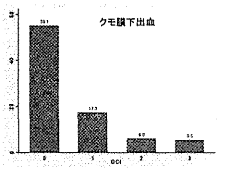
脳梗塞への影響



- 脳梗塞の入院後30日の死亡率は
- OCIが0だと11%
- OCIが3だと2%
- 約1/5になる
- 日本で一番多いのはOCIが1の施設

脳内出血、クモ膜下出血





- 脳出血では
- OCIが1の施設で10.7%
- OCIが3の施設で4.1%

- クモ膜下出血では
- OCIが1の施設17.3.7%
- OCIが3の施設で5.5%

重症度などを調整しても

	OR	P-value	95% CI		
	入院後7日目の死亡				
[illegible]	0.21	<0.001	0.19	-	0.24
[illegible]	0.04	<0.001	0.04	-	0.05
[illegible]	0.04	<0.001	0.03	-	0.05
	入院後30日間の死亡				
[illegible]	0.37	<0.001	0.34	-	0.40
[illegible]	0.10	<0.001	0.09	-	0.11
[illegible]	0.07	<0.001	0.06	-	0.08
	神経障害改善				
[illegible]	1.40	<0.001	1.34	-	1.48
[illegible]	2.06	<0.001	1.93	-	2.20
[illegible]	2.37	<0.001	2.31	-	2.43

OCI2－3の施設は

脳梗塞の30日死亡63%減、神経予後の改善が40%増加など大きな効果があります

- いずれも年齢、性、HT, DM, 脂質異常、チャールソンスコア、意識状態と各施設の効果を調整

結論

- 脳卒中の治療を行う際は
- 多職種の集まった包括的脳卒中センターの役割が多きい
- 脳卒中リハビリ、SCUでの管理、多職種による脳卒中チームによる評価が大事です

御清聴ありがとうございました

厚生労働科学研究　循環器疾患・糖尿病等生活習慣病対策総合研究　推進事業　研究成果発表会
～知っておきたい　脳卒中医療の最前線～
平成28年1月10日（日）　於：JR博多シティ

行政から見た脳卒中を含む循環器病対策

厚生労働省　健康局健康課
高山　啓

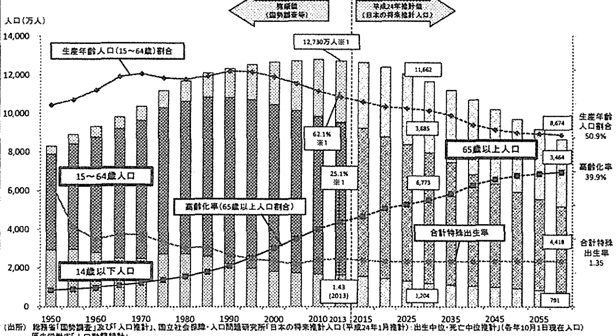
厚生労働省

1

これからの日本の高齢化について

日本の人口の推移

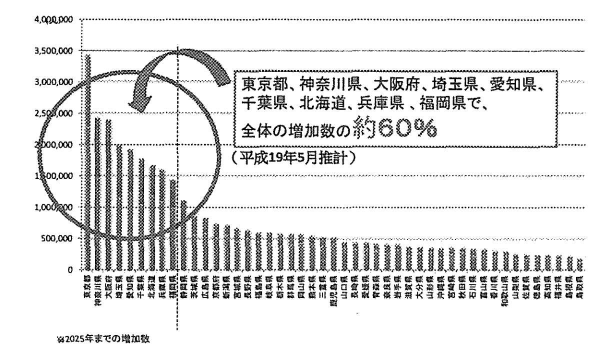
○ 日本の人口は近年横ばいであり、人口減少局面を迎えている。2060年には総人口が9000万人を割り込み、高齢化率は40%近い水準になると推計されている。



（出所）総務省「国勢調査」及び「人口推計」、国立社会保障・人口問題研究所「日本の将来推計人口（平成24年1月推計）：出生中位・死亡中位推計」（各年10月1日現在人口）
厚生労働省「人口動態統計」
※1　出典：平成25年度　総務省「人口推計」（2010年国勢調査においては、人口12,806万人、生産年齢人口割合63.8%、高齢化率23.0%）

3

都道府県別高齢者人口（65歳以上）の増加数
（2005年　→　2025年）



出典：国勢調査（平成17年）
国立社会保障・人口問題研究所「都道府県の将来推計人口（平成19年5月推計）」

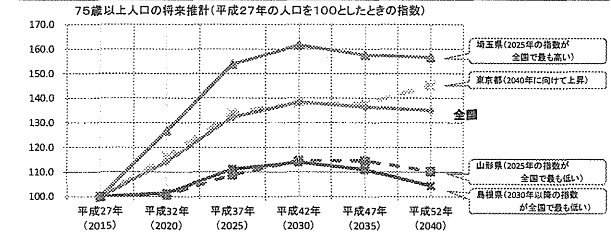
4

2015年～2025年～2040年の各地域の高齢化の状況

○ 75歳以上人口は、多くの都道府県で2025年頃までは急速に上昇するが、その後の上昇は緩やかで、2030年頃をピークに減少する。
※2030年、2035年、2040年でみた場合、2030年にピークを迎えるのが34道府県、2035年にピークを迎えるのが9県
※東京都、神奈川県、滋賀県、沖縄県では、2040年に向けてさらに上昇

○ 2015年から10年間の伸びの全国計は、1.32倍であるが、埼玉県、千葉県では、1.5倍を超える一方、山形県、秋田県では、1.1倍を下回るなど、地域間で大きな差がある。

75歳以上人口の将来推計（平成27年の人口を100としたときの指数）

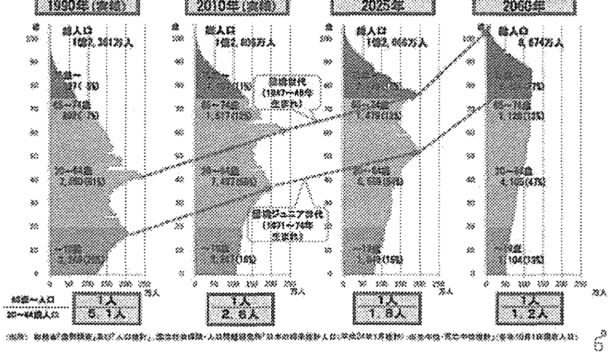


国立社会保障・人口問題研究所「日本の地域別将来推計人口（平成25(2013)年3月推計）」より作成

5

人口ピラミッドの変化（1990～2060年）

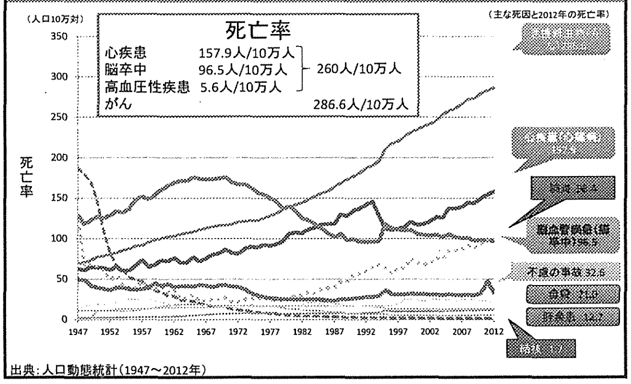
○ 日本の人口構造の変化を見ると、現在1人の高齢者を2.6人で支えている社会構造になっており、少子高齢化が一層進行する2060年には1人の高齢者を1.2人で支える社会構造になると想定



6

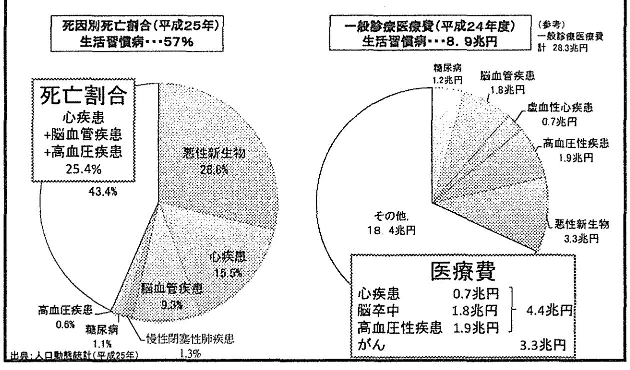
循環器病の現状について

循環器病の死亡率の推移



出典:人口動態統計(1947〜2012年)

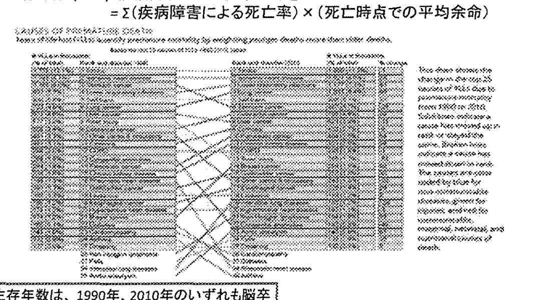
循環器病の死亡割合と医療費



出典:人口動態統計(平成25年)

循環器病の疾病負荷

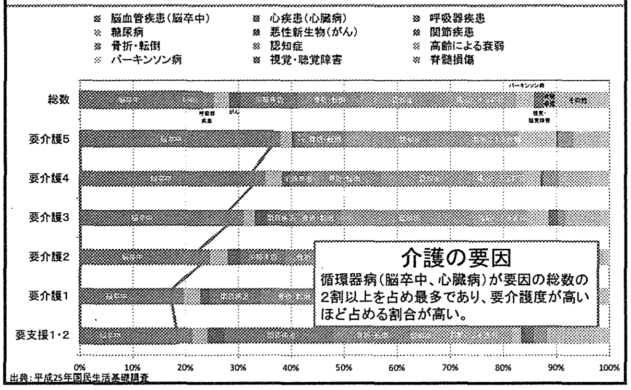
損失生存年数(YLLs):疾病障害により健康寿命を全うできなかった年数
=Σ(疾病障害による死亡率)×(死亡時点での平均余命)



損失生存年数は、1990年、2010年のいずれも脳卒中が1位、虚血性心疾患が2位であり、20年間で増加している。

【資料】GBD PROFILE: JAPAN. http://www.healthmetricsandevaluation.org

介護が必要となった主な要因としての脳卒中



出典:平成25年国民生活基礎調査

循環器病の現状

循環器病:心疾患・脳卒中・高血圧性疾患

- 死亡率(2012年)
  循環器病:260人/10万人　(がん:286.6人/10万人)
- 死亡割合(平成25年)
  循環器病:25.4%　(がん:28.8%)
- 医療費(平成24年度)
  循環器病:4.4兆円　(がん:3.3兆円)
- 疾病負荷(GBD2010)
  1990年、2010年の損失生存年数(YLLs)
  脳卒中:1位、虚血性心疾患2位

循環器病の死亡率、死亡割合はがんに匹敵し、疾病負荷、医療費ではがんを上回る

循環器病の医療体制について

医療計画制度について

趣旨

○ 各都道府県が、地域の実情に応じて、当該都道府県における医療提供体制の確保を図るために策定。
○ 医療提供の量(病床数)を管理するとともに、質(医療連携・医療安全)を評価。
○ 医療機能の分化・連携(「医療連携」)を推進することにより、急性期から回復期、在宅療養に至るまで、地域全体で切れ目なく必要な医療が提供される「地域完結型医療」を推進。

平成25年度からの医療計画における記載事項

○ 新たに精神疾患を加えた五疾病五事業(※)及び在宅医療に係る目標、医療連携体制及び住民への情報提供推進策

※ 五疾病五事業…五つの疾病(がん、脳卒中、急性心筋梗塞、糖尿病、精神疾患)と五つの事業(救急医療、災害時における医療、へき地の医療、周産期医療、小児医療(小児救急医療を含む))をいう。災害時における医療は、東日本大震災の経緯を踏まえて見直し。

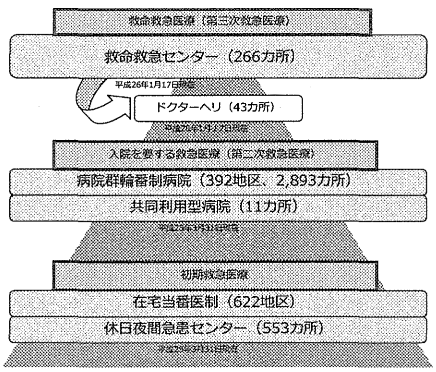
○ 地域医療支援センターにおいて実施する事業等による医師、看護師等の医療従事者の確保
○ 医療の安全の確保　○ 二次医療圏(※)、三次医療圏の設定　○ 基準病床数の算定　等

※ 国の指針において、一定の人口規模及び一定の患者流入・流出割合に基づく、二次医療圏の設定の考え方を明示し、見直しを促進。

【 医療連携体制の構築・明示 】

◇ 五疾病五事業ごとに、必要な医療機能(目標、医療機関に求められる事項等)と各医療機能を担う医療機関の名称を医療計画に記載し、地域の医療連携体制を構築。
◇ 地域の医療連携体制を分かりやすく示すことにより、住民や患者が地域の医療機能を理解。
◇ 指標により、医療資源・医療連携等に関する現状を把握した上で課題の抽出、数値目標を設定、施策等の策定を行い、その進捗状況等を評価し、見直しを行う(疾病・事業ごとのPDCAサイクルの推進)。

救急医療体制の整備



福岡県内の救命救急センター

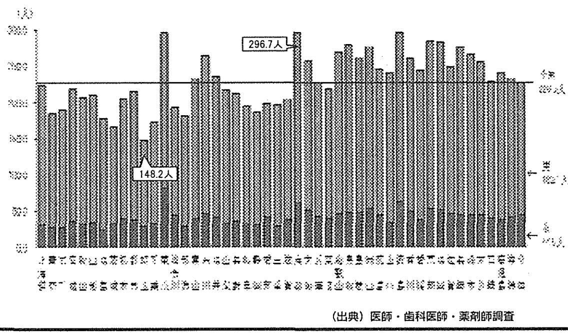
地域名		センター病床数
福岡地域	済生会福岡総合病院救命救急センター	66
	福岡大学病院救命救急センター	40
	九州大学病院救命救急センター	32
北九州地域	北九州市立八幡病院救命救急センター	66
	北九州総合病院救命救急センター	32
筑後地域	久留米大学病院高度救命救急センター	44
	聖マリア病院救命救急センター	31
筑豊地域	飯塚病院救命救急センター	57

医療提供維持のための課題

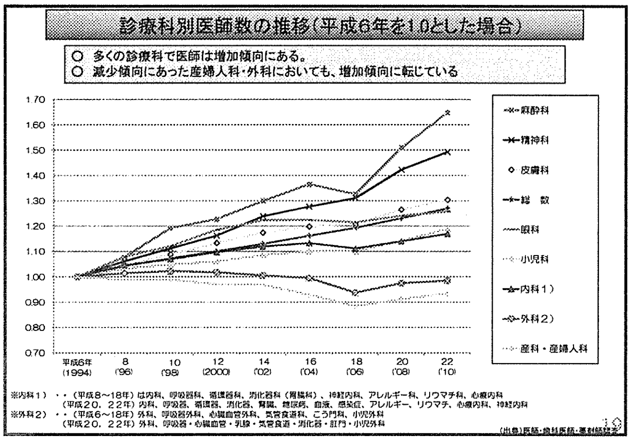
- 医療人材確保
  - ➢特に看護・介護職不足が深刻
- 救急体制維持
  - ➢高齢化が最も影響する分野
- 在宅医療推進
  - ➢8割が自宅外で死亡する半面8割が在宅死を望む
- 高齢期特有の課題
  - ➢脳卒中もそのひとつ

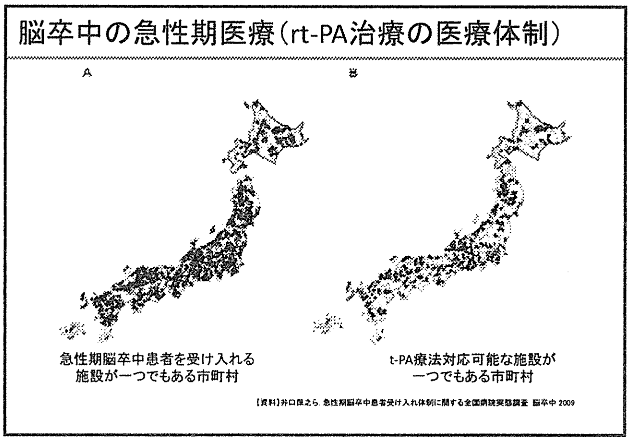
都道府県別にみた人口10万対医師数(平成24年)

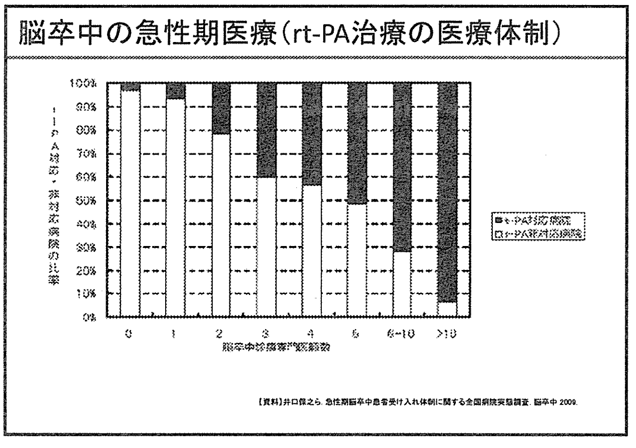
○ 全国の医療施設(診療所・病院)に従事する「人口10万対医師数」は226．5人で、前回に比べ7．5人増加している。
○ 都道府県別では、京都府が最も多く(296．7)、埼玉県が最も少ない(148．2)。



(出典)医師・歯科医師・薬剤師調査







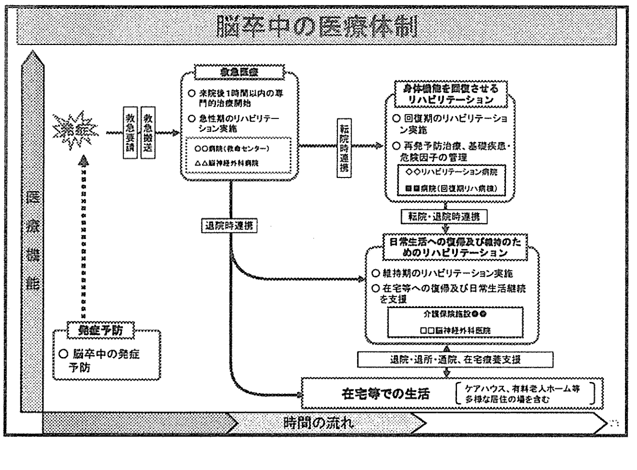
脳卒中　医療体制の目指すべき方向性

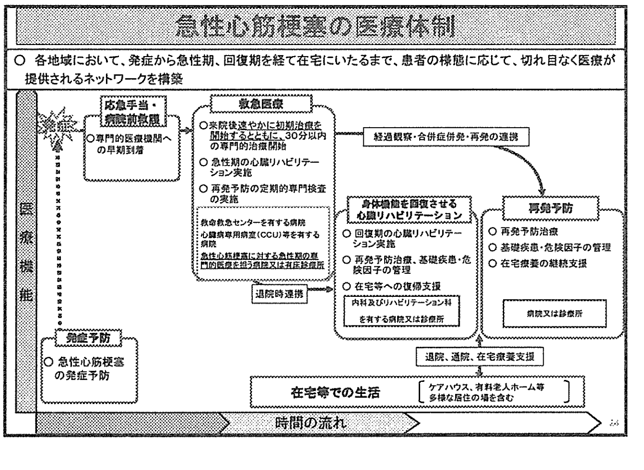
- 今後の脳卒中の医療体制は、個々の医療機能、それを満たす医療機関、さらにそれらの医療機関間の連携により、医療から介護サービスまでが連携し継続して実施される体制を構築することが重要。

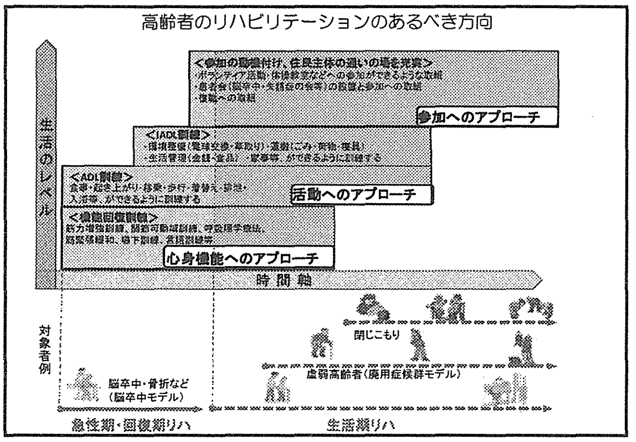
(1)発症後、速やかな搬送と専門的な診療が可能な体制

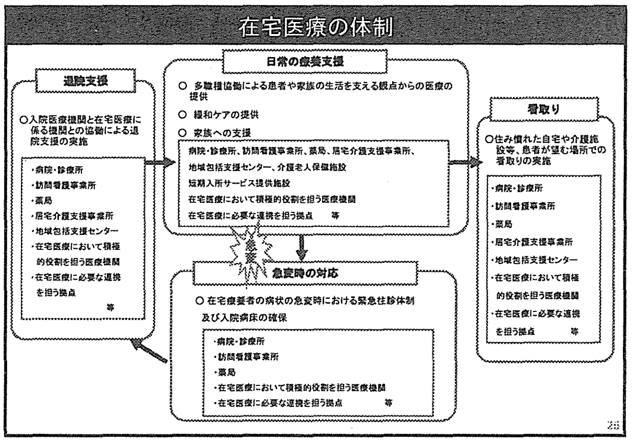
(2)病期に応じたリハビリテーションが可能な体制

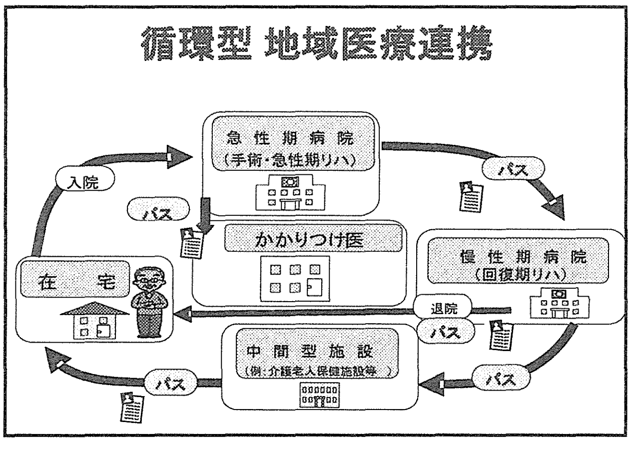
(3)在宅療養が可能な体制











地域医療構想とは・・・

なぜ地域医療構想が必要なのか？
医療における2025年問題

- 2025年とは団塊の世代が75才になる年
  - 医療・介護需要の最大化
- 高齢者人口の増加には大きな地域差
  - 地域によっては高齢者人口の減少が既に開始
- 医療の機能に見合った資源の効果的かつ効率的な配置を促し、急性期から回復期、慢性期まで患者が状態に見合った病床で、状態にふさわしい、より良質な医療サービスを受けられる体制を作ることが必要。

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② 都道府県地域医療構想(ビジョン)

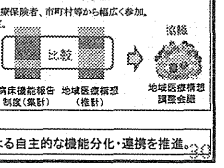
○ 医療計画の一部として策定することから、都道府県医療審議会で議論するとともに、医師会等の地域の医療関係者や住民、市町村等の意見を聴取して、適切に反映。

① 都道府県は、機能分化・連携を図る区域として「構想区域」を設定。
※ 「構想区域」は、現在の2次医療圏を原則とするが、①人口規模、②患者の受療動向、③疾病構造の変化、④基幹病院へのアクセス時間等の要素を勘案して柔軟に設定

② 「構想区域」ごとに、国がお示しするガイドライン等で定める推計方法に基づき、都道府県が、2025年の医療需要と病床の必要量を推計。地域医療構想として策定。

③ 地域医療構想の実現に向けて、都道府県は構想区域ごとに、「地域医療構想調整会議」を開催。
※ 「地域医療構想調整会議」には、医師会、歯科医師会、薬剤師会、看護協会、病院団体、医療保険者、市町村等から幅広く参加。設置区域や参加者の範囲・選定は、地域の事情や議事等に応じて、柔軟に都道府県が設定。

- 病床機能報告制度の報告結果等を基に、現在の医療提供体制と将来の病床の必要量を比較して、どの機能の病床が不足しているか等を検討。
- 医療機関相互の協議により、機能分化・連携について議論・調整。



④ 都道府県は、地域医療介護総合確保基金等を活用し、医療機関による自主的な機能分化・連携を推進。

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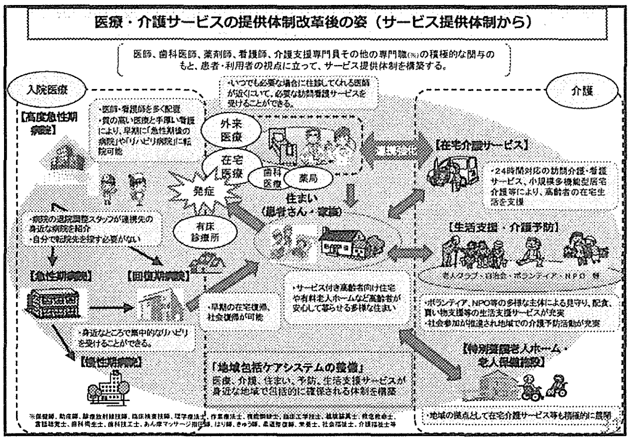

ご静聴ありがとうございました。

(資料 6)

J-ASPECT　Study
発表論文
(平成 27 年度)

1) Iihara K, Nishimura A.　Maternal Death Due to Stroke Associated With Pregnancy-Induced Hypertension.　79(8): 1695-6, 2015
2) Iihara K. Comprehensive Stroke Care Capabilities in Japan: A Neurovascular Surgeon's Perspective. Neurosurgery. 62(Supple1): 107-16,2015

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EDITORIAL

Maternal Death Due to Stroke Associated With Pregnancy-Induced Hypertension

Koji Iihara, MD, PhD; Ataru Nishimura, MD

Pregnancy and the postpartum period are associated with an increased risk of ischemic and hemorrhagic stroke and stroke is the leading cause of pregnancy-related disability. There are few long-term prospective studies of the incidence of stroke in pregnancy. The data from multiple retrospective studies about the incidence and mortality of stroke in pregnancy are summarized in Table 1. Various studies estimate the incidence of all types of stroke in pregnancy and puerperium between 25 and 34 per 100,000 deliveries.[1–8] By comparison, the incidence of stroke in non-pregnant women in the 15–45 years age group is 11 per 100,000 women.[5] A population-based retrospective study conducted from 1988 to 1991 found no increase during pregnancy but a relative risk of 8.7 during the first 6 weeks postpartum.[3] Kuklina et al reported their recent analysis of hospital discharge data from the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project, which is the largest nationwide all-payer inpatient care database in the United States.[4] That report demonstrated that between 1994–1995 and 2006–2007, the rates of antenatal and postpartum hospitalizations for all types of stroke increased by 47% and 83%, respectively.

Article p1835

Risk factors associated with pregnancy-related stroke include hypertension, diabetes, valvular heart disease, hypercoagulable disorders, sickle cell disease, lupus, abuse of tobacco and other substances, and migraines.[1,6] Several studies have demonstrated that hypertensive disorders are the leading cause of both hemorrhagic and ischemic strokes in pregnant and postpartum women.[1–3,6,7] Preeclampsia/eclampsia and pregnancy-induced hypertension (PIH) are the 2 most important hypertensive disorders of pregnancy. Preeclampsia is defined as progressively worsening high blood pressure (BP) in pregnancy, occurring in the setting of proteinuria (≥300 mg of protein in a 24-h urine specimen).[9] Eclampsia is preeclampsia that progresses to seizures. PIH is described as high BP (systolic BP ≥140 mmHg or diastolic BP ≤90 mmHg) after 20 weeks' gestation that occurs without the other signs and symptoms of preeclampsia.

Compared with women without hypertension, women with hypertension complicating pregnancy are 6–9-fold more likely to have a stroke.[5] Therefore, control of PIH is considered to reduce the risk of maternal death from stroke (especially hemorrhagic stroke) during pregnancy. There are few reports about the relationship of maternal death due to stroke and PIH.

In this issue of the Journal, Hasagawa et al review case reports from medical institutions in Japan, and describe the clinical features of maternal death associated with PIH.[10] In this review of maternal deaths in Japan between 2010 and

Table 1. Summary of Studies on the Incidence, Mortality and Morbidity of Pregnancy-Associated Stroke

Study date and first author	Subjects	Incidence (per 100,000 deliveries)	Mortality (%)
Sharshar (1995)[7]	Pregnancy and 2 weeks PP 63 public maternities of the region of Ile de France (1989–1992)	Nonhemorrhagic stroke: 4.3 Hemorrhagic stroke: 4.6	0 (25)
Kittner (1996)[3]	Women aged 15–44 years, pregnancy and 6 weeks PP 46 hospitals in central Maryland and Washington DC (1998–1991)	Ischemic stroke: 11 ICH: 9	
Lanska (1998)[5]	Women aged 15–44 years National Hospital Discharge Survey in the USA (1979–1991)	All strokes: 17.7 CVT: 11.4	3.3 (0)
Lanska (2000)[6]	Women aged 15–44 years National Hospital Discharge Survey in the USA (1993–1994)	All strokes: 13.1 CVT: 11.6	14.7 (0)
Jaigobin (2000)[8]	Pregnancy and 6 weeks PP Tronto Hospital, Canada (1980–1997)	Ischemic stroke: 18 ICH: 8	0 (23)
James (2005)[1]	Pregnancy related discharges Nationwide Inpatient Sample in the USA (2000–2001)	All strokes: 34.2	4.1
Bateman (2006)[2]	Women aged 15–44 years Nationwide Inpatient Sample in the USA (1993–2002)	ICH: 6.1	20.3

CVT, cerebral venous thrombosis; ICH, intracerebral hemorrhage; PP, postpartum.

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Table 2. AHA/ASA Recommendations for Treatment of Hypertension in Pregnancy and PP

Class I recommendation

- Severe hypertension in pregnancy should be treated with safe and effective antihypertensive medications, such as methyldopa, labetalol, and nifedipine, with consideration of maternal and fetal side effects (Level of Evidence A).

Class IIa recommendation

- Consideration may be given to treatment of moderate hypertension in pregnancy with safe and effective antihypertensive medications, given the evidence for possibly increased stroke risk at currently defined systolic and diastolic BP cutoffs, as well as evidence for decreased risk for the development of severe hypertension with treatment (although maternal- fetal risk-benefit ratios have not been established) (Level of Evidence B).
- After giving birth, women with chronic hypertension should be continued on their antihypertensive regimen, with dosage adjustments to reflect the decrease in volume of distribution and glomerular filtration rate that occurs after delivery. They should also be monitored carefully for the development of PP preeclampsia (Level of Evidence C).

Class III recommendation

- Atenolol, angiotensin-receptor blockers, and direct renin inhibitors are contraindicated in pregnancy and should not be used (Level of Evidence C).

BP, blood pressure; PP, postpartum.

2012, 11% of all maternal deaths were associated with PIH. More than 70% of the causes of maternal death associated with PIH were due to stroke, and 12 of 25 deaths (48%) due to stroke were associated with PIH. In this series, the most frequent type of stroke was intracerebral hemorrhage (ICH). Of all stroke types, ICH during pregnancy and the puerperium leads to the highest risk of morbidity and mortality. Pregnancy increases the risk of hemorrhagic more than ischemic stroke (relative risk of 2.5 and 28.5 during pregnancy and the postpartum period).[3] The underlying mechanism of pregnancy-related hemorrhage is likely to be the consequences of physiologic changes, such as blood volume expansion and vascular tissue remodeling in pregnancy, plus the risk from the strain and trauma of labor and delivery. Major causes of pregnancy-related hemorrhage are preeclampsia and eclampsia, which contribute to a large proportion of cases, followed by intracerebral aneurysm, arteriovenous malformation and moyamoya desease.[11,12] The present study revealed that PIH is strongly related with poor outcomes of stroke, especially ICH, associated with pregnancy in Japan.

In February 2014, the American Heart Association and the American Stroke Association released their first guideline focused on stroke prevention in women.[13] Their recommendations are shown in Table 2. Regarding control of hypertension during pregnancy, they recommend that severe hypertension should be treated with safe and effective antihypertensive medications, such as methyldopa, labetalol, and nifedipine, with consideration of maternal and fetal side effects (Class I, Level of Evidence A). For moderate hypertension, consideration may be given with safe and effective antihypertensive medications, given the evidence for possibly increased stroke risk at currently defined systolic and diastolic BP cutoffs, as well as evidence for decreased risk for the development of severe hypertension with treatment (although maternal-fetal risk-benefit ratios have not been established) (Class IIa, Level of Evidence B). In this guideline, high BP during pregnancy is defined as mild (diastolic BP 90–99 mmHg or systolic BP 140–149 mmHg), moderate (diastolic BP 100–109 mmHg or systolic BP 150–159 mmHg), or severe (diastolic BP ≥110 mmHg or systolic BP ≥160 mmHg). They mention that the goal of BP management in pregnancy is to maintain systolic BP between 130 and 155 mmHg and diastolic BP between 80 and 105 mmHg. These recommendations are based on studies of European and American populations. Because there are differences among the races for stroke risk in pregnancy, prospective randomized controlled trials assessing antihypertensive interventions to reduce stroke risk are needed.

An important point in the present study is that although 83% of patients with PIH who died had experienced initial symptoms in a hospital, more than half required medical transport due to lack of local medical resources. They point out that such delays in receiving proper treatment sometimes resulted in maternal death. Although the mortality rate associated with cardiovascular disease such as stroke or acute myocardial infarction is not high in Japan,[10,14] timely transport and treatment of patients who have risk factors in pregnancy, especially PIH, is important for improving the outcome of pregnancy in Japan.

Disclosures

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Comprehensive Stroke Care Capabilities in Japan: A Neurovascular Surgeon's Perspective

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Ladies and gentlemen, it is a great honor for me to give a talk at this annual meeting of the Congress of Neurological Surgeons. The 34th annual meeting of the Japanese Congress was successfully held in Osaka on May 16 to 18, 2014, and >4000 participants exchanged cutting-edge knowledge about neurosurgical techniques and management, clinical and basic science, and social issues related to neurosurgical practice. The theme of the 34th annual meeting of the Japanese Congress was Visionary Approach to Neurosurgery. In this presentation, I wish to briefly review the current status of comprehensive stroke care capabilities in Japan from a neurovascular surgeon's perspective, focusing on healthcare delivery and cutting-edge neurosurgical techniques. This year has afforded me the extraordinary opportunity to work closely with many neurosurgeons across the full spectrum of our specialty. To provide insights into and information for our brighter future, I conducted the first nationwide survey on the real-world setting of neurosurgical practices using data obtained from the Diagnosis Procedure Combination (DPC)–based payment systems. First, I discuss the impact of comprehensive stroke care capabilities on the outcome of ischemic and hemorrhagic stroke revealed by this nationwide study (called the Nationwide Survey of Acute Stroke Capacity for Proper Designation of Comprehensive Stroke Center in Japan, or J-ASPECT Study). Second, I discuss a key role of advanced neuroimaging capabilities in comprehensive stroke centers (CSCs) using our positron emission tomography study for postoperative hyperperfusion in patients with moyamoya disease. Finally, to describe multimodality treatment for complex neurovascular lesions, one of the most important roles and responsibilities of CSCs, I focus on our cutting-edge microsurgical management of partially thrombosed large or giant aneurysms in the posterior circulation.

J-ASPECT STUDY

Increasing attention has been given to defining the quality and value of health care through the reporting of process and outcome measures. In Japan, stroke is the fourth-leading cause of death and a leading cause of long-term disability. Almost 270 000 individuals in Japan have a new or recurrent stroke each year, and nearly 120 000 individuals die after a stroke. In 2000, the Brain Attack Coalition discussed the concept of stroke centers and proposed 2 types of centers: CSCs and primary stroke centers (PSCs).[1,2] Most patients with stroke can be appropriately treated at a PSC, and the Joint Commission has established programs for certifying PSCs and measuring their performance.[3] The concept and recommended key components of CSCs enable intensive care and specialized techniques that are not available at most PSCs. A set of metrics and associated data elements that cover the major types of care distinguishing CSCs from PSCs have been published previously.[1,2]

First, to examine the associations between PSC and CSC capabilities and the impact of CSC capabilities on hospital volume of stroke interventions, we performed the J-ASPECT study, for which a 49-question survey was developed on hospital characteristics (ie, number of beds, academic status, geographic location, and participation in the DPC payment system[4]), PSC and CSC capacity, and hospital volume of stroke interventions.[5] The questionnaire was mailed in February 2011 to the 1369 certified training institutions of the Japan Neurosurgical Society, Japanese Society of Neurology, and Japan Stroke Society. This survey included 25 items related to the 5 major components of CSCs (personnel, diagnostic programs, specific expertise, infrastructure, and educational components) and 5 items related to PSC certification (Tables 1 and 2).[1,2] The availability of personnel was assessed according to 7 categories (eg, board-certified neurologists, board-certified neurosurgeons, and board-certified endovascular physicians). Because the original questions were highly specific, they were modified when necessary. Six advanced neuroimaging capabilities (eg, magnetic resonance imaging [MRI] with diffusion-weighted imaging [DWI] and digital subtraction angiography) were investigated on the basis of their availability 24

TABLE 1. Number (Percentage) of Responding Hospitals (n = 749) With the Recommended Items of Comprehensive Stroke Care Capacity[a]

Components	Items	n (%)
Personnel	Neurologists	358 (47.8)
	Neurosurgeons	694 (92.7)
	Endovascular physicians	272 (36.3)
	Critical care medicine	162 (21.6)
	Physical medicine and rehabilitation	113 (15.1)
	Rehabilitation therapy	742 (99.1)
	Stroke rehabilitation nurses[b]	102 (13.8)
Diagnostic availability 24/7	CT[b]	742 (99.2)
	MRI with diffusion	647 (86.4)
	Digital cerebral angiography[b]	602 (80.8)
	CT angiography[b]	627 (84)
	Carotid duplex ultrasound[b]	257 (34.5)
	TCD[b]	121 (16.2)
Specific expertise	Carotid endarterectomy[b]	603 (80.6)
	Clipping of intracranial aneurysm	685 (91.5)
	Hematoma removal/draining	689 (91.9)
	Coiling of intracranial aneurysm	360 (48.1)
	Intra-arterial reperfusion therapy	498 (66.5)
Infrastructure	Stroke unit[b]	132 (17.6)
	Intensive care unit	445 (59.4)
	Operating room staffed 24/7[b]	451 (60.4)
	Interventional services coverage 24/7	279 (37.3)
	Stroke registry[b]	235 (31.7)
Education	Community education[b]	369 (49.4)
	Professional education[b]	436 (58.6)

[a]CT, computed tomography; MRI, magnetic resonance imaging; TCD, transcranial Doppler; 24/7, 24 h/d, 7 d/wk.
[b]Data missing: stroke rehabilitation nurse, 9; CT, 1; digital cerebral angiography, 4; CT angiography, 3; carotid endarterectomy, 1; carotid duplex, 3; TCD, 3; stroke unit, 1; operating room staffed, 2; stroke registry, 7; community education, 2; and professional education, 5. Reproduced from Iihara et al[5] with permission from the publisher. Copyright © 2014 National Stroke Association.

hours per day, 7 days per week (24/7). The availability of specific expertise for stroke interventions was examined according to 5 categories (eg, carotid endarterectomy and clipping and coiling of intracranial aneurysms). In terms of infrastructure, the availability of 5 items (eg, stroke unit and intensive care unit) was surveyed. Educational/research programs were assessed according to 2 items (community and professional education). Overall organizational and staffing levels of the hospitals in terms of CSC capacity were scored on the basis of the results of a questionnaire referring to 25 items originally recommended by the Brain Attack Coalition (total CSC score).[1] A score of 1 was assigned for each recommended item that was met, resulting in a maximum total CSC score of 25 points. Hospital volume of stroke interventions (eg, tissue-type plasminogen activator [tPA] infusion, removal of intracerebral hemorrhage [ICH], and clipping and coiling of intracranial aneurysms) performed in 2009 was assessed.

Regarding the recommended PSC capabilities, written tPA protocols were available in 85% of hospitals, and the National Institutes of Health Stroke Scale score was routinely documented in 70.7% of hospitals; however, an acute stroke team was available in only 26.5% of hospitals. In terms of the recommended personnel components of CSCs (Table 1), 92.7% of hospitals had a neurosurgeon, 47.8% had a neurologist, and 36.3% had an endovascular physician. The proportions of hospitals with critical care medicine physicians, physical medicine and rehabilitation, and stroke rehabilitation nurses were 21.6%, 15.1%, and 13.8%, respectively. The score for the availability of the personnel component ranged from 0 to 7 points (median, 3; interquartile range [IQR], 2-4).

Computed tomography (CT), MRI with DWI, digital subtraction angiography, and CT angiography (CTA) were available 24/7 in 99.2%, 86.4%, 80.8%, and 84% of institutions, respectively, whereas carotid duplex ultrasonography and transcranial Doppler were available in only 34.5% and 16.2% of hospitals, respectively. The score for the availability of diagnostic components ranged from 0 to 6 points (median, 4; IQR, 4-5).

Carotid endarterectomy, clipping of intracranial aneurysms, and removal of ICH were available in 80.6%, 91.5%, and 91.9% of hospitals, respectively, whereas coiling of intracranial aneurysms and intra-arterial thrombolysis were available in 48.1% and 66.5% of hospitals, respectively. The score for the availability of surgical and interventional components ranged from 0 to 5 points (median, 4; IQR, 3-5).

A stroke unit and an intensive care unit were available in 17.6% and 59.4% of hospitals, respectively. Interventional service coverage on a 24-hour basis was available in 37.3% of hospitals, whereas an operating room staffed 24/7 was available in 60.4% of hospitals. The score of the availability of infrastructure components ranged from 0 to 5 points (median, 2; IQR, 1-3).

Professional and community education was available in 58.6% and 49.4% of institutions, respectively (Table 2). The score of the availability of the educational component ranged from 0 to 2 points (median, 1; IQR, 0-2).

The inclusion of total CSC score, availability of a tPA protocol, and other hospital characteristics in the model revealed that total CSC score, but not availability of a tPA protocol, was significantly associated with the hospital volume of stroke interventions (Figure 1).

UNIQUE ASPECTS OF CSC CAPACITY IN JAPAN

The J-ASPECT study illustrated several unique aspects of CSC capacity in Japan, including higher availability of neurosurgeons (92.7% vs 24%-54% in the United States) and endovascular surgeons (36.3% vs 15%-22% in the United States),[6,7] which was in sharp contrast to the relative shortage of neurologists (47.8% vs 31%-73% in the United States) and other personnel. In the United States, only 7% of neurosurgeons play an active role in nontraumatic cranial emergencies, whereas 59% of the board-certified neurosurgeons in Japan are engaged in stroke care. The

TABLE 2. Characteristics of Comprehensive Stroke Care Capacity According to the Presence or Absence of a Tissue-Type Plasminogen Activator Protocol[a]

Components	Variables	tPA Protocol Present, n (%)	tPA Protocol Absent, n (%)	OR	95% CI	P Value
Personnel	Neurologists	327 (51.3)	31 (27.7)	2.8	1.8-4.3	<.001
	Neurosurgeons	620 (97.3)	74 (66.1)	18.7	10.1-34.8	<.001
	Endovascular physicians	262 (41.1)	10 (8.9)	7.1	3.7-13.9	<.001
	Critical care medicine	151 (23.7)	11 (9.8)	2.9	1.5-5.5	<.001
	Physical medicine and rehabilitation	105 (16.5)	8 (7.1)	2.3	1.2-5.4	.006
	Rehabilitation therapy	632 (99.2)	110 (98.2)	1.14	0.4-12	.36
	Stroke rehabilitation nurses	88 (14)	14 (12.6)	1.1	0.6-2.1	.67
Diagnostic	CT[b]	634 (99.5)	108 (97.3)	5.9	1.2-29.5	.04
	MRI with diffusion	571 (89.6)	76 (67.9)	4.1	2.6-6.6	<.001
	Digital cerebral angiography[b]	554 (87.4)	48 (43.2)	9.1	5.8-14.2	<.001
	CT angiography[b]	566 (89.1)	61 (55)	6.7	4.3-10.5	<.001
	Carotid duplex ultrasound[b]	235 (37)	22 (19.8)	2.4	1.5-3.9	<.001
	TCD[b]	115 (18.1)	6 (5.4)	3.9	1.7-9.1	<.001
Specific expertise	Carotid endarterectomy[b]	554 (87.1)	49 (43.8)	8.7	5.6-13.5	<.001
	Clipping of intracranial aneurysm	619 (97.2)	66 (58.9)	24	13.1-43.7	<.001
	Hematoma removal/draining	621 (97.5)	68 (60.7)	25.1	13.4-46.9	<.001
	Coiling of intracranial aneurysm	344 (54)	16 (14.3)	7	4.1-12.2	<.001
	Intra-arterial reperfusion therapy	465 (73)	33 (29.5)	6.5	4.2-10.1	<.001
Infrastructure	Stroke unit[b]	128 (20.1)	4 (3.6)	6.8	2.5-18.8	<.001
	Intensive care unit	407 (63.9)	38 (33.9)	3.4	2.3-5.3	<.001
	Operating room staffed 24/7	426 (67.1)	25 (22.3)	7.1	4.4-11.4	<.001
	Interventional services coverage 24/7	268 (42.1)	11 (9.8)	6.7	3.5-12.7	<.001
	Stroke registry[b]	229 (36.3)	6 (5.4)	10	4.3-23.1	<.001
Education	Community education[b]	348 (54.8)	21 (18.8)	5.3	3.2-8.7	<.001
	Professional education[b]	413 (65.2)	23 (20.7)	7.2	4.4-11.7	<.001

[a]CI, confidence interval; CT, computed tomography; MRI, magnetic resonance imaging; OR, odds ratio; TCD, transcranial Doppler; tPA, tissue-type plasminogen activator; 24/7, 24 h/d, 7 d/wk.
[b]Data missing: CT, 1; digital cerebral angiography, 4; carotid ultrasound, 3; TCD, 3; carotid endarterectomy, 1; stroke unit, 1; stroke registry, 7; community education, 2; professional education, 5. Reproduced from Iihara et al[5] with permission from the publisher. Copyright © 2014 National Stroke Association.

proportion of Japanese hospitals offering MRI with DWI and CTA corresponded with the gradual increase in the availability of certain special diagnostic tests in the United States, whereas the availability of digital subtraction angiography (80.8%) was in contrast to the temporal decrease in the availability of catheter angiography observed in the state of North Carolina (from 38% in 1998 to 30% in 2008) because of declines in the proportion of hospitals with neurointerventionalists.[8]

A stroke unit/stroke care unit as the critical infrastructure for acute stroke, which has been proven to reduce the number of deaths and long-term dependency,[9] was available in only 17.6% of hospitals in Japan. This was comparable to the proportion observed in hospitals in the United States (6.6%-28%).[6-8]

The implementation of a written tPA protocol as a key item of PSC capacity was used to determine the relationship between PSC and CSC capacity because it is a key step in reducing tPA-related complications[2,10] (Table 2). The availability of a tPA protocol (85%) was comparable to that reported in 2 US statewide studies performed in Illinois in 2000 (72.8%) and North Carolina between 1998 (43%) and 2008 (69%).[6,8] Notably, facilities with a tPA protocol in Japan had a higher availability of nearly all (92%) recommended items of CSC capacity, with the exception of personnel in rehabilitation therapy and stroke rehabilitation nurses. However, in a previous study performed in the United States,[6] no significant differences were noted in the availability of a larger number of critical items corresponding to the CSC items in this study (eg, endovascular physicians, CTA, conventional cerebral angiography, carotid duplex ultrasound, intra-arterial thrombolysis, stroke unit, and community stroke awareness program) based on the presence of a tPA protocol. Therefore, CSC capacity was more likely to coexist in hospitals with PSC capacity in Japan than in the United States, which might be explained by a relatively larger commitment of neurosurgeons in acute stroke care (eg, tPA infusion) in Japan.

IMPACT OF CSC CAPABILITIES ON IN-HOSPITAL MORTALITY IN PATIENTS WITH ISCHEMIC OR HEMORRHAGIC STROKE (J-ASPECT STUDY)

Next, I would like to discuss the impact of CSC capabilities on outcomes in patients with ischemic or hemorrhagic stroke. As

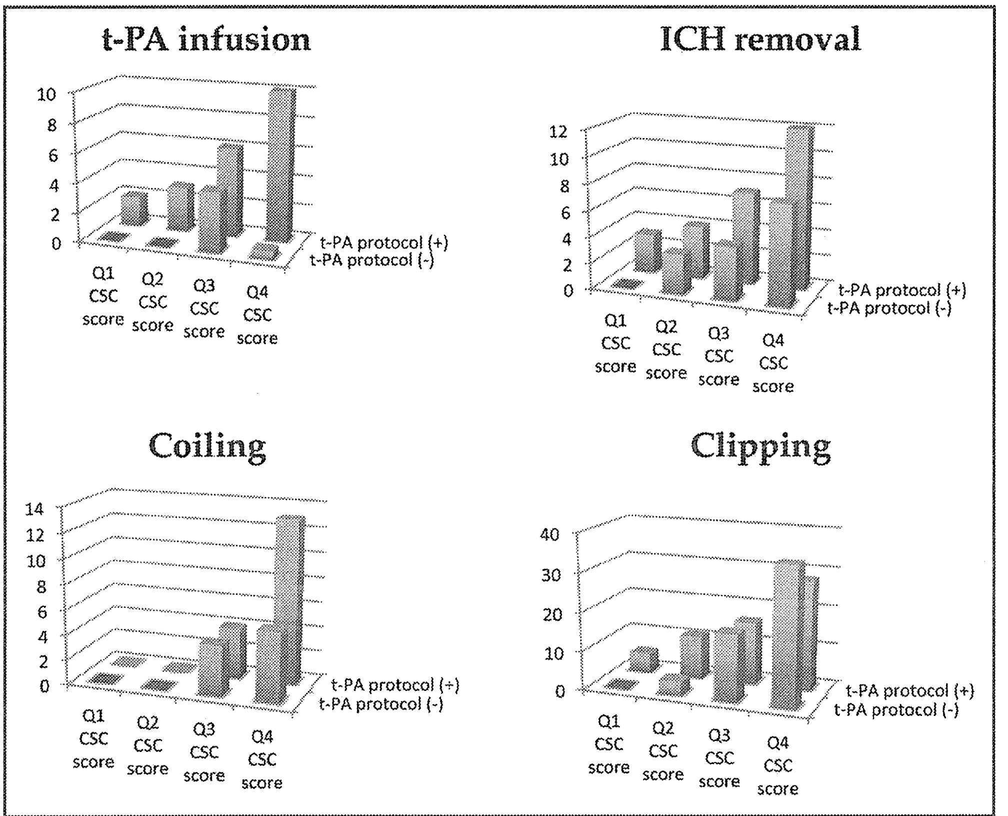

FIGURE 1. *Associations between primary and comprehensive stroke care capabilities and case volume of tissue-type plasminogen activator (tPA) infusion, intracerebral hemorrhage (ICH) removal, and coiling and clipping of intracranial aneurysms in 2009 in Japan. The inclusion of total comprehensive stroke care (CSC) score, availability of a tPA protocol, and other hospital characteristics in the model revealed that total CSC score, but not availability of a tPA protocol, was significantly associated with the hospital volume of stroke interventions. Q, quintile.*

a specialty, we have to step back and ask the very fundamental question, What evidence exists that any of these CSC capabilities have improved stroke outcomes? At the beginning of this project, no evidence existed on the impact of CSC capabilities on outcomes in patients with ischemic or hemorrhagic stroke. Among the institutions that responded to the questionnaire on CSC capacity, data on patients hospitalized for stroke between April 1, 2010, and March 31, 2011, were obtained from the Japanese DPC database.[11] The DPC is a mixed-case patient classification system that was launched in 2002 by the Ministry of Health, Labor, and Welfare of Japan and was linked with a lump-sum payment system.[12] Computer software was developed to identify patients hospitalized because of acute stroke from the annual deidentified discharge database using the *International Classification of Diseases, 10th Revision* diagnosis codes related to ischemic stroke (I63.0-9), nontraumatic ICH (I61.0-9, I62.0-1, and I62.9), and subarachnoid hemorrhage (I60.0-9).[11] The following data were collected from the database: unique identifiers of hospitals, patient age and sex, diagnoses, comorbidities at admission, in-hospital use of medications (antihypertensive agents, oral hypoglycemic agents, insulin, antihyperlipidemic agents, statins, anticoagulant agents, or antiplatelet agents), smoking, arrival by ambulance, level of consciousness at admission according to the Japan Coma Scale, and discharge status. The Japan Coma Scale[13] was originally published in 1974, the same year as the Glasgow Coma Scale,[14] and it remains one of the most popular grading scales among healthcare professionals and emergency medical service personnel in Japan for assessing impaired consciousness. Grading with the 1-, 2-, and 3-digit codes corresponds to the following status: (1) the patient is awake in the absence of any stimulation, (2) the patient can be aroused but reverts to the previous state after the cessation of stimulation, and (3) the patient cannot be aroused even by forceful mechanical stimulation. Zero on the scale indicates normal consciousness. In-hospital mortality was analyzed with hierarchical logistic regression analysis adjusted for age, sex, level of consciousness on admission, comorbidities, and the number of fulfilled CSC items in each component and in total.

Data from 265 institutions and 53170 emergency-hospitalized patients were analyzed (Table 3).[11] The distribution of total CSC

TABLE 3. Demographics of the Patient Study Cohort at the Time of Diagnosis and Hospital Characteristics According to Stroke Type Between April 1, 2010, and March 31, 2011 in Japan[a]

	Total (n = 53 170)	Ischemic Stroke (n = 32 671)	Intracerebral Hemorrhage (n = 15 699)	Subarachnoid Hemorrhage (n = 4934)
Male	29 353 (55.2)	18 816 (57.6)	9030 (57.5)	1584 (32.1)
Age, mean ± SD, y	72.5 ± 13.1	74.4 ± 12.2	70.7 ± 13.5	64.7 ± 14.8
Hypertension	39 918 (75.1)	22 531 (69.0)	13 281 (84.6)	4229 (85.7)
Diabetes mellitus	13 725 (25.8)	9318 (28.5)	3278 (20.9)	1174 (23.8)
Hyperlipidemia	15 015 (28.2)	11 104 (34.0)	2529 (16.1)	1412 (28.6)
Smoking (n = 44842)	12 761 (24.0)	8188 (25.1)	3540 (22.5)	1074 (21.8)
Medications during hospitalization				
Antihypertensive agent	34 136 (64.2)	17 694 (54.2)	12 537 (79.9)	4019 (81.5)
Anti–renin-angiotensin system agent	19 881 (37.4)	10 262 (31.4)	8280 (52.7)	1410 (28.6)
Calcium channel antagonist	25 984 (48.9)	10 469 (32.0)	11 719 (74.6)	3903 (79.1)
Sympathetic antagonist	6334 (11.9)	3821 (11.7)	2172 (13.8)	364 (7.4)
β-blocker[b]	4357 (8.2)	3048 (9.3)	1133 (7.2)	188 (3.8)
α-blocker	2374 (4.5)	953 (2.9)	1232 (7.8)	200 (4.1)
Diuretic agent	9950 (18.7)	5860 (17.9)	3074 (19.6)	1049 (21.3)
Loop diuretic	7434 (14.0)	4609 (14.1)	1912 (12.2)	940 (19.1)
Other diuretic	4425 (8.3)	2527 (7.7)	1653 (10.5)	255 (5.2)
Antidiabetic agent	10 295 (19.4)	6784 (20.8)	2473 (15.8)	1075 (21.8)
Insulin	7654 (14.4)	4597 (14.1)	2044 (13.0)	1046 (21.2)
Oral antidiabetic agent	5749 (10.8)	4459 (13.6)	1110 (7.1)	197 (4.0)
Antihyperlipidemic agent	12 387 (23.3)	9264 (28.4)	1839 (11.7)	1310 (26.6)
Statin	10 099 (19.0)	7840 (24.0)	1366 (8.7)	912 (18.5)
Antiplatelet agent	23 635 (44.5)	21 746 (66.6)	625 (4.0)	1298 (26.3)
Aspirin	11 929 (22.4)	11 119 (34.0)	378 (2.4)	447 (9.1)
Japan Coma Scale score				
0	19 635 (36.9)	15 027 (46.0)	3620 (23.1)	1024 (20.8)
1-digit code	19 371 (36.4)	12 375 (37.9)	5934 (37.8)	1117 (22.6)
2-digit code	6937 (13.0)	3396 (10.4)	2705 (17.2)	852 (17.3)
3-digit code	7227 (13.6)	1873 (5.7)	3440 (21.9)	1941 (39.3)
Emergency admission by ambulance	31 995 (60.2)	17 336 (53.1)	10 909 (69.5)	3830 (77.6)
Average time in hospital (range), d	21 (11-40)	20 (12-38)	22 (10-43)	30 (12-54)
Hospital characteristics (mean ± SD CSC scores)				
Total score (25 items)		16.7 ± 3.8	16.8 ± 3.4	17.1 ± 3.4
Personnel (7 items)		3.7 ± 1.2	3.7 ± 1.2	3.8 ± 1.2
Diagnostic techniques (6 items)		4.4 ± 1.1	4.5 ± 1.0	4.5 ± 1.0
Specific expertise (5 items)		4.4 ± 1.0	4.4 ± 0.9	4.5 ± 0.8
Infrastructure (5 items)		2.8 ± 1.3	2.9 ± 1.3	2.9 ± 1.3
Education (2 items)		1.4 ± 0.8	1.4 ± 0.8	1.4 ± 0.8

[a]CSC, comprehensive stroke center.
[b]A composite variable with a pure β antagonist and a mixed α/β-adrenergic antagonist (eg, labetalol). Reproduced from Iihara et al[11] with permission.

scores ranged from 1 to 23 (mean, 15.4; standard deviation, 4.2; median, 14; IQR, 11-18). Mortality rates were 7.8% for patients with ischemic stroke, 16.8% for patients with ICH, and 28.1% for patients with subarachnoid hemorrhage. Mortality of patients with ischemic stroke was significantly correlated with the patient characteristics of male sex (odds ratio [OR] = 1.23), age (10 incremental years, OR = 1.4), and level of consciousness (1-digit code, OR = 2.4; 2-digit code, OR = 7.46; 3-digit code, OR = 21.62 vs zero as the control) and the hospital characteristics of total CSC score (OR = 0.97) adjusted for age, sex, and level of consciousness (Table 4). Mortality of patients with ICH was also significantly correlated with the patient characteristics of male sex (OR = 1.72), age (10 incremental years, OR = 1.36), and level of consciousness (1-digit code, OR = 1.45; 2-digit code, OR = 4.22; 3-digit code, OR = 49.59 vs zero as the control) and the hospital characteristic of total CSC score (OR = 0.97) adjusted for age, sex, and level of consciousness (Table 5). Mortality of patients with subarachnoid hemorrhage was also significantly correlated with the patient characteristics of male sex (OR = 1.39), age (10 incremental years, OR = 1.37), and level of consciousness (2-digit code, OR = 2.01; 3-digit code, OR = 17.12 vs zero as the control) and the hospital characteristic of total CSC score (OR = 0.95)

TABLE 4. The Impact of Total Comprehensive Stroke Care Score on In-Hospital Mortality After Ischemic Stroke Adjusted by Age, Sex, and Level of Consciousness at Admission According to the Japan Coma Scale[a]

Factor	OR	95% CI	*P* Value
Male sex	1.23	1.12-1.35	<.001
Age	1.40	1.34-1.47	<.001
CSC total score	0.97	0.96-0.99	.001
JCS			
Normal	1		
1-digit code	2.40	2.11-2.74	<.001
2-digit code	7.46	6.47-8.60	<.001
3-digit code	21.62	18.69-25.02	<.001

[a]CI, confidence interval; CSC, comprehensive stroke care; JCS, Japan Coma Scale; OR, odds ratio. Reproduced from Iihara et al[11] with permission.

TABLE 6. The Impact of Total Comprehensive Stroke Care Score on In-Hospital Mortality After Subarachnoid Hemorrhage Adjusted by Age, Sex, and Level of Consciousness at Admission According to the Japan Coma Scale[a]

Factor	OR	95% CI	*P* Value
Male sex	1.39	1.17-1.65	<.001
Age	1.37	1.29-1.45	<.001
CSC total score	0.95	0.93-0.98	<.001
JCS			
Normal	1		
1-digit code	1.05	0.75-1.46	.79
2-digit code	2.01	1.46-2.77	<.001
3-digit code	17.13	13.14-22.35	<.001

[a]CI, confidence interval; CSC, comprehensive stroke care; JCS, Japan Coma Scale; OR, odds ratio. Reproduced from Iihara et al[11] with permission.

adjusted for age, sex, and level of consciousness (Table 6). Therefore, total CSC score was independently associated with in-hospital mortality for all stroke types after adjustment for age, sex, and stroke severity. The impact of total CSC score on in-hospital mortality for ischemic stroke and ICH remained significant after adjustment for age, sex, severity of stroke, and existence of comorbid conditions (hypertension, diabetes mellitus, and hyperlipidemia; data not shown). Figure 2 shows the impact of total CSC score classified into quintiles (quintile 1, 4-12; quintile 2, 13-14; quintile 3, 15-17; quintile 4, 18; quintile 5, 19-23) on the in-hospital mortality of patients with all types of stroke, ischemic stroke, ICH, and subarachnoid hemorrhage after adjustment for age, sex, and level of consciousness. In summary, we found that the total CSC score was significantly associated with in-hospital mortality rates regardless of stroke type after adjustment for age, sex, and initial level of consciousness according to the Japan Coma Scale.

TABLE 5. The Impact of Total Comprehensive Stroke Care Score on In-Hospital Mortality After Intracerebral Hemorrhage Adjusted by Age, Sex, and Level of Consciousness at Admission According to the Japan Coma Scale[a]

Factor	OR	95% CI	*P* Value
Male sex	1.72	1.54-1.92	<.001
Age	1.36	1.30-1.42	<.001
CSC total score	0.97	0.95-0.99	.003
JCS			
Normal	1		
1-digit code	1.45	1.14-1.83	.002
2-digit code	4.22	3.34-5.33	<.001
3-digit code	49.59	40.12-61.27	<.001

[a]CI, confidence interval; CSC, comprehensive stroke care; JCS, Japan Coma Scale; OR, odds ratio. Reproduced from Iihara et al[11] with permission.

At present, no official certification of stroke centers in Japan has been launched, and the present study indicates that patients with acute ischemic stroke or hemorrhagic stroke are being admitted on an emergent basis to hospitals with similar CSC total and subcategory scores, as measured with the use of 25 items originally recommended by the Brain Attack Coalition. Although there is increasingly good evidence from initiatives like Get With The Guidelines–Stroke[15] that a process based on the systematic collection and evaluation of stroke performance measures can rapidly improve the quality of stroke care delivered by hospitals, current metrics are limited mostly to process measures that address the care of patients with ischemic stroke in acute hospital-based settings.[16] In addition, there is a pressing need to demonstrate a direct link between better adherence to stroke performance measures and improved patient-oriented outcomes.[3,17] Finally, one could argue that there really is no concept of "3 of 4" CSCs but rather only CSCs or PSCs. In light of the existing evidence regarding the impact of the recommended CSC items on stroke outcomes, we advocate a CSC scoring system that examines the impact of the availability of the recommended items on in-hospital mortality for all types of stroke. Considering the marked impact of the CSC score on mortality after all types of stroke, the differential impacts of CSC subcategory scores for different stroke types may make a single, simple, and effective CSC criterion unrealistic to produce a nationwide reduction in stroke mortality. In our opinion, it may be a more viable option to use CSC scores in a more limited fashion, that is, to benchmark the state of care currently provided by medical centers treating stroke patients.

ADVANCED NEUROIMAGING CAPABILITIES AT THE CSC

Advanced neuroimaging capabilities such as MRI and various types of cerebral angiography are a key area for a CSC that is

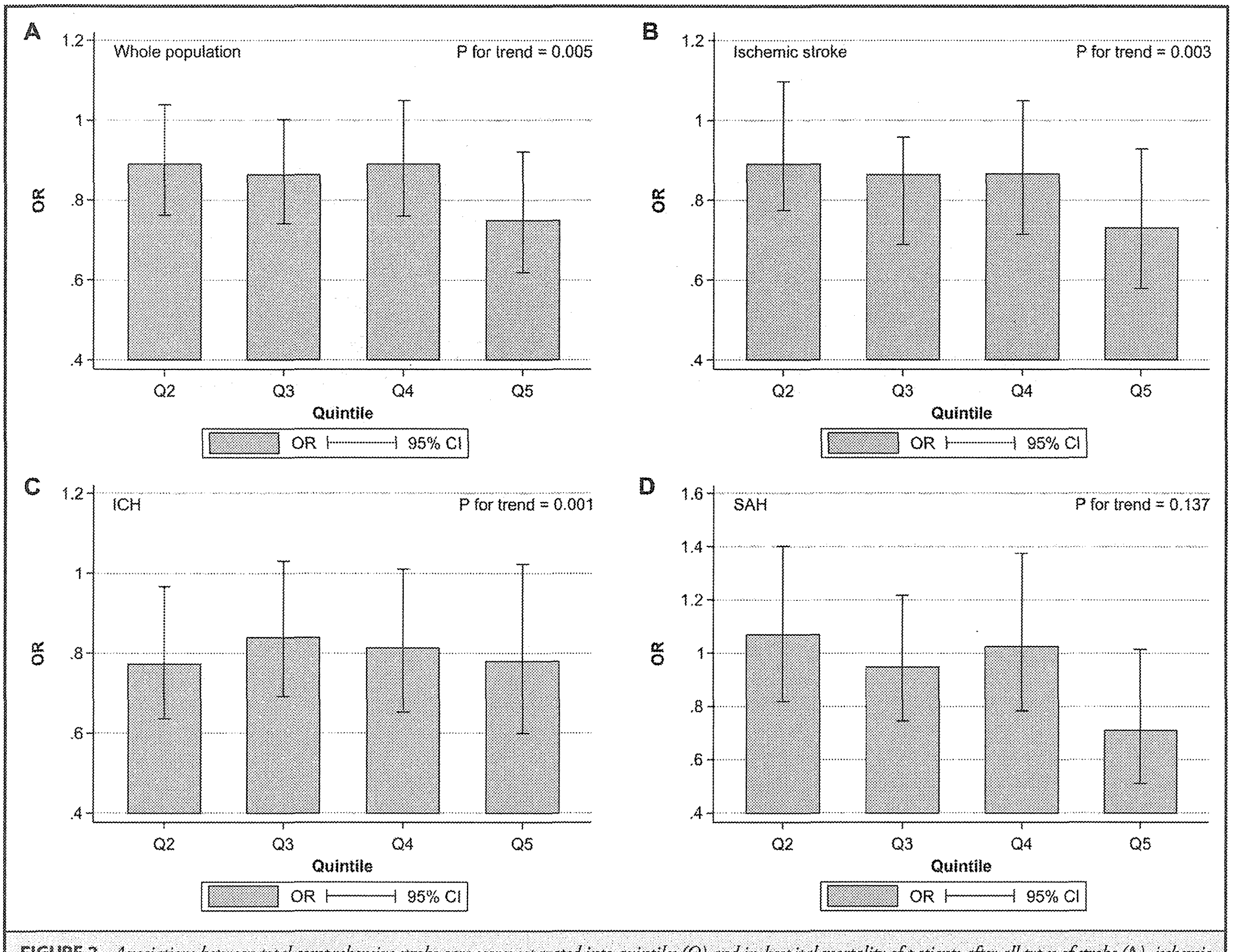

FIGURE 2. *Associations between total comprehensive stroke care scores separated into quintiles (Q) and in-hospital mortality of patients after all types of stroke (A), ischemic stroke (B), intracerebral hemorrhage (ICH; C), and subarachnoid hemorrhage (SAH; D) after adjustment for age and sex. Odds ratios (ORs) and 95% confidence intervals (CIs) of in-hospital mortality for each quintile are depicted compared with that of Q1 as the control (Q1, 4-12 points; Q2, 13-14 points; Q3, 15-17 points; Q4, 18 points; Q5, 19-23 points).* Reproduced from Iihara et al[11] *with permission.*

supported by evidence-based medicine. Here, I describe the role of tests for cerebral blood flow and metabolism using positron emission tomography in hyperperfusion after revascularization in patients with moyamoya disease. These parameters have not been quantitatively analyzed in these patients in any previous study. Despite favorable long-term outcomes after successful surgery for moyamoya disease, increasing evidence suggests that this may be complicated by temporary neurological deterioration during the postoperative acute stage owing to focal cerebral hyperperfusion around the site of the anastomosis. We found that an increased oxygen extraction fraction preoperatively was the only significant risk factor for postoperative hyperperfusion, and 2 patients with markedly increased cerebral metabolic rates of oxygen at hyperperfusion were complicated with postoperative seizures.[18] This study revealed that symptomatic hyperperfusion in moyamoya disease is characterized by temporary increases in cerebral blood flow >100% of preoperative values caused by prolonged recovery of increased cerebral blood volume and illustrated a critical role of advanced neuroimaging capabilities in CSCs to clarify the pathophysiology of a rare but clinically important phenomenon using positron emission tomography, considering its difficult logistics.[18,19]

MULTIMODALITY TREATMENT FOR COMPLEX NEUROVASCULAR LESIONS

Multimodality treatment for complex neurovascular lesions is one of the most important roles and responsibilities for CSCs.

FIGURE 3. *Computed tomography angiograms of a partially thrombosed giant aneurysm of the basilar tip in a 59-year-old man with progressive diplopia.*

Next, I illustrate our cutting-edge microsurgical management of partially thrombosed large or giant aneurysms in the posterior circulation.[20]

Giant thrombosed aneurysms often present with symptoms related to the mass effect by compressing the surrounding neural structure. Because their natural history is extremely poor, early intervention should be considered; however, the optimum treatment of giant thrombosed aneurysms remains unknown because it is often difficult to surgically manage these anomalies owing to their location, wide neck, calcification, or intra-aneurysmal thrombosis, especially in the posterior circulation. Therefore, flow alteration or isolation strategies are often considered as the first line of treatment for such unclippable aneurysms[21-23]; however, there are several critical issues to be considered in these strategies. The most important issue is the prediction of a reduced mass effect after flow alteration or isolation strategies, especially if the aneurysm is symptomatic.[24-26] Another important issue is the fate of critical perforators around the neck of the aneurysms after such treatment.

ILLUSTRATIVE CASE

A 59-year-old man presented with progressive diplopia. CTA demonstrated a partially thrombosed giant aneurysm at the basilar tip with a maximum diameter of 37 mm (Figure 3). A maximum flow reduction strategy was used for this case (Figure 4). The right P1 was hypoplastic; bilateral posterior communicating arteries were well developed; and the left superior cerebellar artery originated near the basilar tip. A combination of proximal basilar clip occlusion and left superficial temporal artery–superior cerebellar artery bypass was performed with a subtemporal approach. To prevent inadvertent occlusion of the critical perforators in response to flow alteration, aspirin was administered perioperatively. Patency of the superficial temporal artery–superior cerebellar artery bypass and patency of the critical perforators from the basilar artery adjacent to the clip were confirmed with indocyanine green videoangiography. Postoperative angiography showed no filling of the aneurysm with good patency of the bypass (Figure 5). No new ischemic lesion was noted on postoperative DWI-MRI. The diplopia gradually improved in response to this operation.

Over the past 5 years, I have operated on >20 cases of such partially thrombosed large or giant aneurysms in the posterior circulation treated by flow alteration as a main operator. Postoperatively, marked shrinkage of the aneurysm was achieved in 24% of the cases (unpublished data).

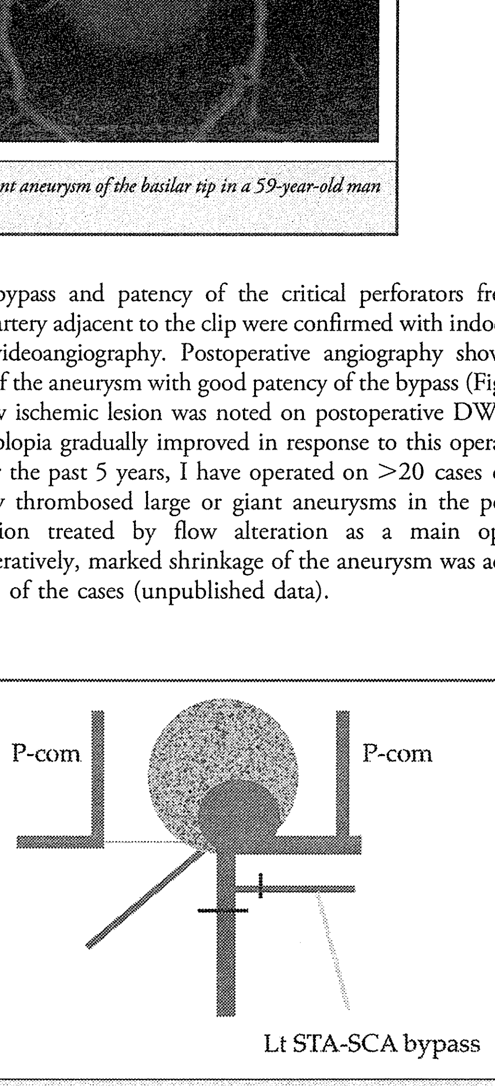

FIGURE 4. *Concept of maximum flow reduction strategy applied to a 59-year-old man (seen also in Figure 3) with a partially thrombosed giant aneurysm of the basilar tip in progressive diplopia. Aspirin was used perioperatively to preserve the critical perforators. Lt STA-SCT, left superficial temporal artery–superior cerebellar artery; P-com, posterior communicating artery.*

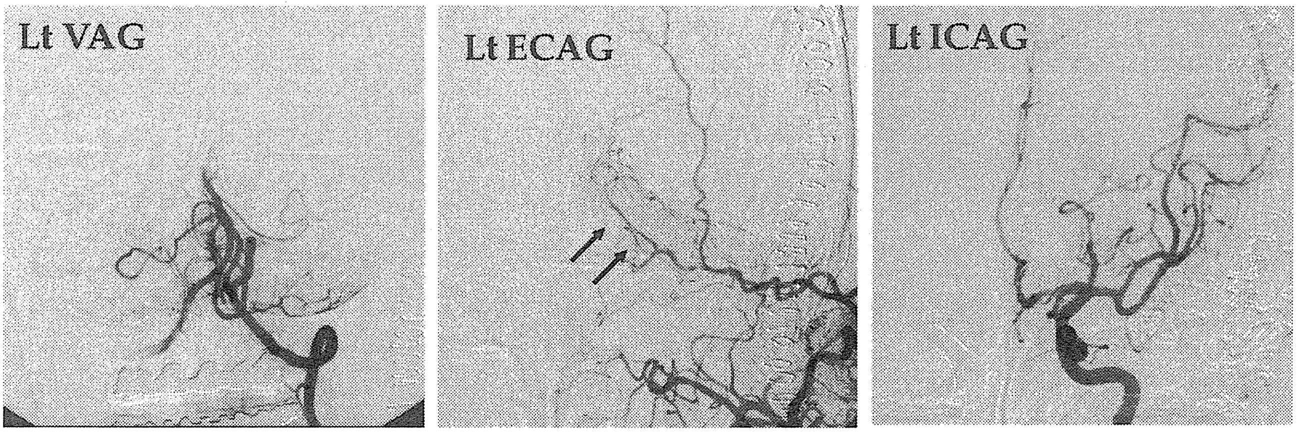

FIGURE 5. *Postoperative angiograms of a 59-year-old man (also shown in Figures 3 and 4) with progressive diplopia and a partially thrombosed giant aneurysm of the basilar tip showing complete obliteration of the aneurysm and good patency of the left superficial temporal artery–superior cerebellar artery aneurysm. Lt ECAG, left external carotid arteriography; Lt ICAG, left internal carotid arteriography; Lt VAG, left vertebral arteriography.*

CONCLUSION

Here, I briefly summarized the current status of CSC capabilities in Japan from a neurovascular surgeon's perspective, including a nationwide survey of CSC capabilities, the impact of CSC capabilities on stroke mortality outcomes, a role of advanced neuroimaging capabilities in clinical stroke research, and multimodality treatment for complex neurovascular lesions.

Disclosures

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