ORIGINAL ARTICLE

Results of a questionnaire survey on pregnancy-associated stroke from 2005 to 2012 in Aichi Prefecture, Japan

Yasumasa Ohno¹, Madoka Furuhashi², Kaoru Ishikawa³, Haruomi Kondo⁴, Shigeaki Kaseki⁵, Fumitaka Kikkawa⁶

¹Ohno Ladies Clinic, ²Department of Obstetrics and Gynecology, Nagoya First Red Cross Hospital, ³Department of Regeneration of Medicine in Kuwana District, Suzuka University of Medical Science, ⁴Hoshigaoka Maternity Hospital, ⁵Kaseki Hospital, ⁶Department of Obstetrics and Gynecology, Nagoya University Graduate School of Medicine

Reprint request to:

Yasumasa Ohno, M.D., Ph.D.,
Ohno Ladies Clinic, 10 Takahata,
Inari-cho, Iwakura City, Aichi,
482-0012, Japan.
E-mail: yasumasa@ohno-clinic.jp

Key words:

eclampsia, hypertension,
pregnancy, questionnaire survey,
stroke

Received: February 4, 2014

Revised: May 18, 2014

Accepted: May 25, 2014

Aim: Our aim was to establish a therapeutic strategy for eclampsia, stroke, and hypertension during pregnancy in Japan.

Methods: A questionnaire survey was sent to all obstetric institutions in Aichi Prefecture in order to collect information on characteristics of eclampsia and stroke during pregnancy as well as management of hypertension during labor and puerperium from 2005 to 2012.

Results: Of 518,024 deliveries, 203 cases of eclampsia (0.04%) and 51 cases of stroke (0.01%) were reported. Roughly 40% of eclampsia and stroke occurred at primary medical institutions, while 26% of strokes occurred at home. Most were managed at intensive medical institutions and 7 stroke patients died. Strokes occurred antepartum (41%), during labor (18%), and postpartum (41%). Most medical institutions measured blood pressure (BP) during labor and puerperium. During labor and puerperium, 15% of institutions allowed the supporting medical staff to decide whether or not the BP values should be reported.

Conclusions: This unique, long-term survey to address eclampsia and pregnancy-associated stroke enabled us to obtain detailed information and assess several issues regarding the maternal transport system, collaboration with neurosurgeons and ambulance services, and BP management during labor and puerperium in Japan.

Introduction

Eclampsia and stroke during pregnancy are major causes of maternal and neonatal death in many countries.^{1–3)} Despite the ubiquity of these conditions and their public health impacts, neither their etiologies nor therapeutic strategies for their treatment have been established. In addition, most incidences of eclampsia and stroke occur during labor and puerperium, and sometimes result in maternal death. The lack of etiological information about eclampsia, stroke, and hypertension around the time of delivery makes it difficult to propose appropriate management strategies.

Previously, we reported our findings from a questionnaire-based study of eclampsia and stroke during pregnancy involving all obstetric institutions in Aichi Prefecture (AICHI DATA).⁴⁾ Aichi Prefecture comprises

6% of the Japanese population as well as 7% of annual births in Japan. Therefore, AICHI DATA could provide useful etiological information regarding eclampsia and stroke during pregnancy in Japanese mothers. Continued analysis of AICHI DATA has allowed us to obtain additional and significant findings. For the purposes of the present study, the questionnaire results provided information on characteristics of eclampsia and stroke during pregnancy as well as measurement of hypertension during pregnancy and puerperium to establish therapeutic strategies for patients affected by these conditions.

Materials and methods

We conducted three questionnaire-based studies of eclampsia and stroke during pregnancy that targeted all obstetric institutions in Aichi Prefecture in 2007

Table 1. Incidence and location of eclampsia and stroke occurrence during pregnancy in Aichi Prefecture from 2005 to 2012

	Total	Intensive institution	Primary institution	Home
Number of institutions				
2007	166	52	114	–
2012	144	46	98	–
Number of deliveries (%)	518,024 (100)	177,900 (34)	340,124 (66)	–
Eclampsia				
Onset (%)	203 (100)	118 (58)	77 (38)	8 (4)
Managed (%)	203 (100)	189 (93)	14 (7)	0 (0)
Stroke				
Onset (%)	51 (100)	18 (35)	20 (39)	13 (26)
Managed (%)	51 (100)	51 (100)	0 (0)	0 (0)

Table 2. Annual trends in eclampsia in Aichi Prefecture

	Total	2005	2006	2007	2008	2009	2010	2011	2012
Delivery	518,024	63,512	67,311	62,431	65,007	64,338	64,393	65,755	65,277
Eclampsia	203	25	29	22	31	19	21	26	30
Onset time									
Antepartum	39 (19%)	3	4	4	7	3	4	7	7
During labor	75 (37%)	12	11	6	12	9	5	10	10
Postpartum	89 (44%)	10	14	12	12	7	12	9	13
Prognosis									
After-effects (–)	202	24	29	22	31	19	21	26	30
After-effects (+)	1	1	0	0	0	0	0	0	0
Death	0	0	0	0	0	0	0	0	0

(166 institutions), 2010 (155 institutions), and 2012 (144 institutions). All institutions responded to our questionnaires, which were designed to obtain detailed information about eclampsia and stroke during pregnancy. The present study evaluated the questionnaire results by focusing on characteristics of eclampsia and stroke during pregnancy, as well as measurement of blood pressure (BP) during pregnancy and puerperium.

Financial support was provided by the Perinatal Care Association of the Aichi Prefectural Government.

Results

Characteristics of eclampsia and stroke

From 2005 to 2012, 518,024 deliveries were reported in Aichi Prefecture. These included 203 cases of eclampsia (0.04%) and 51 cases of stroke (0.01%). Thirty-eight percent of eclampsia and 39% of strokes occurred at primary medical institutions, while 26% of strokes occurred at home. Most incidences of eclampsia (93%) and all strokes were managed at intensive medical institutions (Table 1).

Eclampsia episodes occurred antepartum (19%),

during labor (37%), and postpartum (44%). All patients with eclampsia showed good prognoses except for one patient who suffered a neurologic after-effect (Table 2).

Strokes occurred antepartum (41%), during labor (18%), or postpartum (41%). Seven stroke patients died (3 cerebral hemorrhages, 3 subarachnoid hemorrhages [SAH], and 1 cerebral venous thrombosis), while 15 patients suffered neurologic after-effects (Table 3). Stroke cases included 15 cerebral hemorrhages, 9 SAH, 1 arteriovenous malformation (AVM), 4 moyamoya disease, 14 cerebral infarctions, 3 cerebral venous thromboses, and 3 posterior reversible encephalopathy syndrome (PRES). The majority (78%) of strokes which occurred during labor were cerebral hemorrhages. The most common forms of stroke occurring in puerperium were cerebral hemorrhage (19%), SAH (29%), and cerebral infarction (29%). While cerebral hemorrhage (21%) and SAH (33%) had high mortality, cerebral infarction caused no maternal deaths (Table 4).

Blood pressure (BP) measurement during labor in 2012

BP measurements were obtained for all patients during

Table 3. Annual trends in stroke during pregnancy in Aichi Prefecture

	Total	2005	2006	2007	2008	2009	2010	2011	2012
Delivery	518,024	63,512	67,311	62,431	65,007	64,338	64,393	65,755	65,277
Stroke	51	2	7	4	4	9	6	10	9
Onset time									
Antepartum	21 (41%)	0	2	1	1	5	3	6	3
During labor	9 (18%)	1	1	0	1	0	2	1	3
Postpartum	21 (41%)	1	4	3	2	4	1	3	3
Prognosis									
After-effects (-)	29	0	4	2	3	5	4	6	5
After-effects (+)	15	2	1	1	0	2	2	4	3
Death	7	0	2	1	1	2	0	0	1

Table 4. Classification of stroke during pregnancy

	Total	CH	SAH	AVM	MD	CI	CVT	PRES	Other
Stroke	51	15	9	1	4	14	3	3	2
Institution of Onset									
Intensive care	18	6	3	0	4	1	2	2	0
Primary care	20	8	4	0	0	5	0	1	2
Home	13	1	2	1	0	8	1	0	0
Onset time									
Antepartum	21	4	3	1	2	8	1	2	0
During labor	9	7	0	0	2	0	0	0	0
Postpartum	21	4	6	0	0	6	2	1	2
Therapy									
Conservative	37	7	7	1	3	13	2	3	1
Surgery	9	6	1	0	1	0	1	0	0
Prognosis									
After-effects (-)	29	5	6	0	2	11	1	3	1
After-effects (+)	15	7	0	1	2	3	1	0	1
Death	7	3	3	0	0	0	1	0	0

CH, cerebral hemorrhaging; SAH, subarachnoid hemorrhaging; AVM, arteriovenous malformation; MD, moyamoya disease; CI, cerebral infarction; CVT, cerebral venous thrombosis; PRES, posterior reversible encephalopathy syndrome.

Table 5. Blood pressure measurement during labor in 2012

	Total 144	Intensive Institution 46	Primary Institution 98
Measurements taken			
All cases	76 (53%)	31	45
BP $\geq$ 140/90 mmHg at admission	26 (18%)	5	21
Upon doctor request only	20 (14%)	6	14
Decided by supporting medical staff	15 (10%)	4	11
None	0	0	0
Others	7	0	7
Report to doctor			
All cases	13 (9%)	0	13
BP $\geq$ 140/90 mmHg	84 (58%)	27	57
BP $\geq$ 150/100 mmHg	20 (14%)	5	15
BP $\geq$ 160/110 mmHg	2 (1%)	1	1
Decided by supporting medical staff	21 (15%)	12	9
Others	4	1	3

BP, blood pressure.

Table 6. Blood pressure measurement trends in puerperium

	Total 144	Intensive institution 46	Primary institutions 98
Measurements taken			
All cases	126 (88%)	43	83
Upon doctor request only	12 (8%)	3	9
Decided by supporting medical staff	2 (1%)	0	2
None	1	0	1
Others	3	0	3
Number of measurements taken			
1/day	69	30	39
2/day	34	5	29
3/day	15	3	12
Report measurements to doctor			
All cases	12 (8%)	0	12
BP $\geq$ 140/90 mmHg	87 (60%)	28	59
BP $\geq$ 150/100 mmHg	16 (11%)	4	12
BP $\geq$ 160/110 mmHg	3 (2%)	2	1
Decided by supporting medical staff	22 (15%)	12	10
Others	4	0	4

BP, blood pressure.

labor at 53% of institutions, while 18% only measured BP for patients who presented with BP values greater than 140/90 mmHg on admission. Institutions that allowed supporting medical staff to decide when to take BP measurements comprised 10%, indicating a decrease from the 14% reported by a previous study in 2010.⁴⁾ With regard to criteria for reporting BP data to doctors, 9% of institutions reported all data, while 58% only reported BP values greater than 140/90 mmHg. The decision to report these values was left up to supporting medical staff at 15% of institutions, indicating a decrease from the 23% reported by a previous study in 2010.⁴⁾ These findings revealed that BP measurement strategies during labor were left up to the supporting medical staff at roughly 15% of institutions (Table 5).

BP measurements in puerperium were taken for all patients at 88% of institutions. BP data were reported to doctors for all patients at 8% of institutions, 60% only reported BP values greater than 140/90 mmHg, and 15% left reporting decisions to the supporting medical staff (Table 6).

Discussion

AICHI DATA is a unique, long-term etiological study of eclampsia and pregnancy-associated stroke in Japan, as it comprises useful information obtained from patients at both primary and intensive medical institutions. Continuous development of “AICHI DATA” has enabled us to obtain more detailed information pertaining to 518,024 deliveries in Aichi Prefecture from 2005 to 2012.

Of these, 203 cases of eclampsia (0.04%) and 51 cases of stroke (0.01%) were reported, and correspond to similar rates reported in other countries.^{1–3,5)}

Approximately 40% of strokes occurred at primary medical institutions, and 26% of them occurred at home. All strokes were managed at intensive medical institutions. These data highlight the importance of not only appropriate diagnoses at primary medical institutions, but also the establishment of efficient inter-institution transport systems and collaboration with ambulance services, similar to that required for dealing with eclampsia.

More than half of the strokes in our sample population occurred either during labor or postpartum. This also indicates that the prevention of stroke and eclampsia through appropriate antihypertensive management around delivery is important.

In our previous report, 1,013 pregnancy cases were classified into 4 groups: the normotensive group ($n=761$, 75%), in which systolic BP (SBP) remained below 140 mmHg throughout labor; the mildly hypertensive group ($n=186$, 18%), in which the maximum SBP during labor ranged from 140/90 mmHg to 160/110 mmHg; the severely hypertensive group ($n=50$, 5%), in which the maximum SBP during labor ranged from 160/110 mmHg to 180/120 mmHg; and the emergent hypertensive group ($n=16$, 2%),^{6,7)} in which the maximum SBP during labor was greater than 180 mmHg. Of the 927 cases that displayed normal BP on admission, 129, 28, and 9 cases demonstrated mild hypertension, severe hypertension, and emergent hypertension, respectively, between admission

and delivery. We advocate that clinicians should pay attention to the presence of hypertension that occurs for the first time during delivery. In addition, repetitive BP measurements are necessary for the successful management of hypertension during labor.

This study found that BP measurement strategies during labor were left up to the supporting medical staff at roughly 15% of institutions, indicating a decrease from that reported by a previous study in 2010.⁴⁾ If a patient develops hypertension, the supporting medical staff must report the patient's BP to a doctor immediately and discuss the necessity of medical intervention.

Tan reported that roughly 10% of maternal deaths in the United Kingdom were due to hypertensive disorders in puerperium.⁸⁾ Walters reported that BP rose progressively over the first 5 postnatal days, peaking on days 3 to 6 postpartum.⁹⁾ In this study, 4 of the 7 maternal deaths were due to a stroke occurring in puerperium. Forty-four percent of eclampsia incidences and 41% of strokes occurred in puerperium, indicating the importance of accurate antihypertensive management. However, 15% of institutions left reporting decisions of BP values to the supporting medical staff. Thus, in cases involving postpartum hypertension, the supporting medical staff must report the BP values to a doctor and discuss the necessity of medical intervention.

In this study, 90% of institutions began the use of hypotensors when patient BP reached 160/110 mmHg or lower, while 5% began when systolic BP reached 180 mmHg. The Joint National Committee in America and European Society of Hypertension proposed to reduce BP in patients whose BP is greater than 180/120 mmHg (hypertensive emergencies).^{10,11)}

Home BP measurement (HBPM) is becoming increasingly utilized in many countries and is well accepted by hypertensive patients. The European Society of Hypertension has endorsed the use of HBPM in clinical practice as a useful adjunct to conventional office measurements.¹²⁾ HBPM may be one available tool that can be used to predict and manage hypertension during pregnancy and puerperium. In this study, 85% of institutions used HBPM as a tool to predict hypertension after discharge (data not shown).

This study also highlighted several issues, including the currently poor state of the intra-institutional maternal transport system, the lack of established criteria for BP reporting around the time of delivery, the availability

of HBPM, and the importance of collaborating with ambulance services.

AICHI DATA will be continuously developed in the future, and is anticipated to supply more important and etiological data from Japanese subjects.

Acknowledgements

This work was supported in part by the Perinatal Care Association of the Aichi Prefectural Government.

Conflict of interest

None.

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