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Table 1. Characteristics of cases and controls, 2006-2011.

		Cases (n=117)		Controls (n=304)	
		Mean	SD	Mean	SD
Age	year	60.46	13.77	64.34	11.33
Aneurysm diameter	mm	6.4	3.40	5.1	3.20
Total cholesterol	mg/dl	186.12	49.89	198.71	36.02
LDL-C	mg/dl	113.24	40.34	115.03	29.25
HDL-C	mg/dl	56.7	18.45	59.88	16.69
Triglyceride	mg/dl	109.34	65.90	132.48	80.98
		Number	%	Number	%
Male		41	35.0%	104	34.2%
Statin use		11	9.4%	79	26.0%
Family history of SAH		13	11.1%	40	13.2%
The concomitant diseases	Hypertension*	57	48.7%	177	58.2%
	Diabetes mellitus	3	2.6%	24	7.9%
	Hyperlipidemia	33	28.2%	105	34.5%
	Heart disease	5	4.3%	28	9.2%
	Previous stroke (except SAH)	1	0.9%	3	1.0%
Medications	Antihypertensive drug use	36	30.8%	162	53.3%
	Aspirin	10	8.5%	36	11.8%
	Vitamin K antagonist, including warfarin,other antiplatelet drug	2	1.7%	24	7.9%

	Steroid	3	2.6%	1	0.3%
	Nonsteroidal antiinflammatory drugs	2	1.7%	10	3.3%
	Use of other lipid- lowering drugs	4	3.4%	13	4.3%
Cigarette smoking	Never	67	57.3%	177	58.2%
	Past	13	11.1%	83	27.3%
	Current smoker	37	31.6%	41	13.5%
Alcohol consumption	Never	58	49.6%	138	45.4%
	Past	3	2.6%	13	4.3%
	Current drinking	56	47.9%	150	49.3%

LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SAH, subarachnoid hemorrhage.

* Hypertension was defined as doctor-diagonosed hypertension and/or treatment with antihypertensive drugs.

Table 2. Adjusted odds ratios* of cerebral aneurysm rupture in 117 cases and 304 controls.

Variables		Adjusted odds ratios	95% CI
Statin use	Yes	0.30	0.14-0.66
	No	1 (reference)	
Sex	Male	1 (reference)	
	Female	0.80	0.39-1.61
Age	(unit: ten years)	0.88	0.69-1.10
Hypertension **	Yes	0.99	0.58-1.69
	No	1 (reference)	
Serum total cholesterol	(unit: 10mg/dl)	0.93	0.87-0.99
Cigarette smoking	Never	1 (reference)	
	Past	0.33	0.14-0.78
	Current	1.72	0.84-3.50
Alcohol consumption	Never	1 (reference)	
	Past	0.46	0.09-2.42
	Current	0.72	0.40-1.32

CI, confidence interval.

* Adjusted odds ratios were calculated using logistic regression analsis including all variables in the same model.

** Hypertension was defined as doctor-diagonosed hypertension and/or treatment with antihypertensive drugs.

Table 3. Adjusted odds ratios* of cerebral aneurysm rupture for statin use, stratified by serum total cholesterol levels.

Serum total choresterol level	Statin use	Case Number	%	Control Number	%	Crude odds ratio	95% CI	Adjusted odds ratio	95% CI
Less than 130mg/dl	Yes	2	13.3%	0	0.0%	-	-	-	-
	No	13	86.7%	4	100.0%	-	-	-	-
	Total	15	100.0%	4	100.0%				
130-219mg/dl	Yes	5	7.7%	50	28.4%	0.21	0.08-0.55	0.20	0.07-0.56
	No	60	92.3%	126	71.6%	1 (reference)	-	1 (reference)	-
	Total	65	100.0%	176	100.0%				
220 mg/dl or greater	Yes	2	8.0%	10	16.9%	0.43	0.09-2.10	0.32	0.04-2.28
	No	23	92.0%	49	83.1%	1 (reference)	-	1 (reference)	-
	Total	25	100.0%	59	100.0%				

CI, confidence interval.

* Logistic regression analysis were used to estimate odds ratios adjusted for sex, age, hypertension, smoking and alcohol consumption.

Title page

Title: Inadequate communication between patients with unruptured cerebral aneurysms and neurosurgeons

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Key words: unruptured cerebral aneurysm, risk communication, shared decision making, treatment, support tool

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Abstract

There is no clinical report in Japan about the communication between patients with cerebral aneurysms and consulting neurosurgeons. In this paper, we performed clinical surveys in patients with unruptured cerebral aneurysms and their neurosurgeons after ordinary explanation of the disease and its treatment options and expected outcomes in clinic visits using a one-page written questionnaire about treatment options, treatment decisions to patients and their neurosurgeons. The numbers of participated patients and neurosurgeons were 42 and 9, respectively, and the 42 paired patient-neurosurgeon responses were obtained. Agreement was considerably low (kappa= 0.17–0.30 for 6 categorized scales and kappa=0.44–0.67 for 2 categorized scales) regarding the "best" treatment for each patient as agreed on by the patient and neurosurgeon. Agreement in the understanding of treatment options and general application was unexpectedly low (kappa= 0.21, 0.01 for 6 scales and kappa=NA, −0.03 for 2 categorized scales). There was a tendency that agreement was higher in experienced neurosurgeons and their patients than non-experienced neurosurgeons and their patients. Patients estimated much higher risks of stroke or death after surgical intervention or no intervention compared with the estimates offered by their neurosurgeons ($p<0.001$).

Text

Introduction

Cerebral aneurysms have a potential risk of subarachnoid hemorrhage (SAH), and preventive treatments are considered depending on various factors including the size, shape and location of aneurysms, past history of SAH, family history, patient's age and clinical conditions. Particularly in Japan, brain check-up with MR imaging is popular and often recommended for elder people and a chance to detect unruptured cerebral aneurysms has been increasing 6). Patients with unruptured cerebral aneurysms consult neurosurgeons who have a responsibility to inform patients and their family about information of their aneurysms, natural history of cerebral aneurysms, treatment options and treatment outcomes and risks. Because there are several treatment options for unruptured cerebral aneurysms including surgical clipping, endovascular coiling, observation with/without serial radiological assessment, and there is no definite way of assessment for risks of rupture from an individual cerebral aneurysm nor definite treatment for each unruptured cerebral aneurysm, clinical decision-making and informed consent between patients and neurosurgeons are often difficult and may be biased depending on doctor's experience and their subspeciality and patients' preference 1).

In order to obtain a better risk communication between patients with unruptured cerebral aneurysms and their neurosurgeons, we have executed a study of "u-CARE; Unruptured Cerebral Aneurysm study for better Risk communication and Evidence-based decision making" 1,2,6,7). U-CARE includes the clarification of natural history and treatment risks of unruptured cerebral aneurysms, the evaluation of

treatment selection and preference by patients and neurosurgeons, the assessment of mental changes after the diagnosis and treatment of unruptured cerebral aneurysms, and the construction of support tools and guidelines. King et al reported the failure to communicate between patients with cerebral aneurysms and vascular neurosurgeons in US 4). Although Japanese and Finnish have a higher risk of rupture from cerebral aneurysms 9), there is no clinical report in Japan about the communication between patients with cerebral aneurysms and consulting neurosurgeons. In this paper, we performed clinical surveys in patients with unruptured cerebral aneurysms and their neurosurgeons immediately after ordinary explanation of the disease and its treatment options and expected outcomes in clinic visits. We used a one-page written questionnaire about treatment options, treatment decisions to patients and their neurosurgeons, and compared the responses to assess whether an adequate communication is accomplished.

Patients and Methods

We surveyed patients with unruptured cerebral aneurysms and their neurosurgeons in neurosurgical clinics at Shiga University of Medical Science and six affiliated hospitals between February 2010 and August 2010. Patients were included in this study if they were over 20 years old, and informed of the presence of unruptured cerebral aneurysms within 3 years, and more than 2 times of ordinary explanation were performed previously from consulting neurosurgerons regarding the natural history and treatment options and risks and expected outcomes. Neurosurgeons were included if they had a Japan board of neurosurgery. Institutional ethical committees approved the protocol and informed consent was obtained from all patients prior to data acquisitions. We

used a one-page written questionnaire with 6 questions about treatment options, treatment decisions to patients and their neurosurgeons. We collected data on demographics, medical history, aneurysm characteristics and treatments.

The questionnaire asked patients and neurosurgeons to rate in 6 point Likert scales upon:

(1) the "best" treatment for each patient as agreed on by the patient and neurosurgeon (4 questions)

(2) the understanding of treatment options and general application (2 questions)

The scale ranged from "strongly agree" to "strongly disagree" to assess the appropriateness of various treatment options and how well the patient understood them 5). Then patients and their neurosurgeons were asked to mark 10 cm horizontal visual analogue scale (VAS) to indicate their estimate of the risk (0-100%) of stroke or death for 20 years with no intervention and that after surgical intervention (either surgical clipping or endovascular coiling).

Data analysis

Demographics were tabulated and calculated for continuous variables. Likert 6 point scale responses were further collapsed into two categories (agree and disagree) to simplify data analysis (Figure 1). Paired patient-neurosurgeon Likert scale responses and consensus treatment responses were compared using unweighted kappa scores. Kappa scores assess how closely two raters agree beyond that expected from chance alone and quantify agreement as follows: 0-0.20, slightly agreement; 0.21-0.40, fair agreement; 0.41-0.60, moderate agreement; 0.61-0.80, substantial agreement; 0.80-1.00, almost agreement. Paired patient-neurosurgeon VAS responses were examined using

the Spearman correlation test. Comparison of the median estimates of the risk of stroke or death was tested by Wilcoxon signed rank test. Two tailed p values <0.05 were considered significant. All statistical analyses were done by R version 2.13.2 3.

Results

The numbers of participated patients and neurosurgeons were 42 and 9, respectively, and the 42 paired patient-neurosurgeon responses were obtained. Mean patient age was 62.0±10.7 (35-79) and male:female was 16:26. Patients demographyics were shown in Table 1. The patient numbers for each neurosurgeons were not uniform ranging from 1 to 8, and the number of experienced neurosurgeons (defined as over 20 years after obtaining Japan neurosurgical board) were 4.

Agreement was considerably low (κ = 0.17–0.31 for 6 categorized scale and κ =0.44–0.67 for 2 categorized scale) regarding the "best" treatment for each patient as agreed on by the patient and neurosurgeon (Table 2). Agreement in the understanding of treatment options and general application was unexpectedly low (κ = 0.12, 0.01 for 6 scale and κ =NA, -0.03 for 2 categorized scale).

If neurosurgeons are divided into experienced and non-experienced neurosurgeons, there is a tendency that agreement was higher in experienced neurosurgeons and their patients than non-experienced neurosurgeons and their patients (Table 3). Agreement in the understanding of treatment options was also lower in non-experienced neurosurgeons and their patients. Agreement in the understanding of general application was low regardless of neurosurgeons' experience.

Patients estimated much higher risks of stroke or death after surgical intervention or no intervention compared with the estimates offered by their neurosurgeons. The

median estimates of the risk of stroke or death for 20 years with no intervention were 45% for patients and 20% for neurosurgeons ($p=0.006$). The median estimates of the risk of stroke or death after surgical intervention were 10% for patients and 5% for neurosurgeons ($p<0.001$).

Discussion

SAH from ruptured cerebral aneurysms attacks upon middle-aged and elderly people and clinical outcomes are still serious not only from overall prognosis but also from social and occupational point of view. Nearly half of survivors suffer from personal changes or memory disturbances and cannot return to full-time job 8). Japanese people seem to have a higher risk of rupture as compared with other races 9), and risk of rupture from unruptured cerebral aneurysms has been extensively investigated to assess clinical evidence of the risk in Japan.

Surgical intervention is considered in patients harboring unruptured cerebral aneurysms with high risk of rupture to relieve them from risk of rupture. However, the risk of rupture from unruptured cerebral aneurysms varies in each patient and depends on various factors such as aneurysm characteristics including the size, shape and location of aneurysms and patient's characteristics including past history of SAH, family history, patient's age, smoking, hypertension, and the application of preventive surgical intervention depends on patient's characteristics including patient's age, clinical conditions, patient's and family preferences and neurosurgeon's characteristics including each doctor's experiences, subspeciality and institutional policy 1). In Japan, brain check-up with MR imaging easily detect unruptured cerebral aneurysms particularly in elderly patients, and neurosurgeons have a responsibility to inform patients and their

family about information of their aneurysms, natural history of their aneurysms, treatment options and treatment risks and outcomes.

This paper shows considerably low agreement between patients and their neurosurgeons in the best selection of treatment options for each patient, and almost no agreement in the understanding of treatment options and their application in general. A previous report by King et al also showed the similar results 4). They indicated that the variety of treatment options in unruptured cerebral aneurysms might affect a communication between patients and their neurosurgeons. Several treatment options might contribute to make patient's clinical outcomes better if each treatment is adequately applied to properly selected patients, and better understanding and shared decision making before treatment should be necessary to obtain patient's acceptance and satisfaction after the treatment.

Patient's perception for risks of unruptured cerebral aneurysms and their treatments may be more sensitive than that of the neurosurgeon. The mean patient risk estimates of stroke or death after surgical intervention and no intervention were much higher than those of neurosurgeons. Brain check-up reveal asymptomatic intracranial diseases including unruptured cerebral aneurysms in apparently healthy people, and adequate clinical explanation and mental care are necessary in order to avoid exaggerated anxiety and unnecessary treatment for patients. By now, objective data including risk of rupture, risk of treatment do not seem to be enough for better mutual understanding and shared decision making, and communication tools for support of patient's mentality may be necessary.

We have continued a study of "u-CARE; Unruptured Cerebral Aneurysm study for better Risk communication and Evidence-based decision making" since 2004, and have

conducted several clinical trial to clarify natural history and treatment risks of unruptured cerebral aneurysms, to evaluate treatment selection and preference by patients and neurosurgeons, to assess mental changes after the diagnosis and treatment of unruptured cerebral aneurysms, in order to produce support tools for a better communication between patients and neurosurgeons 1,2,6,7). By now, web-based and DVD support tools have been produced and their effectiveness was evaluated 6). They included the medical information about unruptured cerebral aneurysms, and were effective in educating patients and their family with objective information regarding unruptured cerebral aneurysms. However, support tools for shared decision-making should provide patients and their family with adequate and enough information for final decision, and much information without solid data does not necessarily mean the agreement of best treatment option in each patient.

Conclusion

The agreement between patients with unruptured cerebral aneurysms and their neurosurgeons is considerably low regarding the treatment selection and understanding of the disease. The patient's risk estimation seems to be higher than the doctor's. Further assessment is needed to construct support tools for the establishment of shared decision making in the treatment of unruptured cerebral aneurysms

List of participating institutes (alphabetically ordered): Kohka Public Hospital, Koto Memoral Hospital, Kusatsu General Hospital, Nagahama Red Cross Hospital, Omihachiman Community Medical Center, Second Okamoto General Hospital, Shiga Unversity Hospital

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Disclosures

None.

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Figure Legends

Figure 1 Matrix of numbers of patients and neurosurgeons responses of the question: open surgery is the best treatment for my aneurysm. Shaded cells indicate agreement between patients and neurosurgeons existed on 19/42=45.2% of survey pairs (κ =0.62)

Figure 1

			Neurosurgeons						
			1[a]	2[a]	3[a]	4[a]	5[a]	6[a]	Total
			1[b]			2[b]			
Patients	Original scale (6 categorized scale)	2 categorized scale							
	1[a]	1[b]	4	2	1	0	0	0	7
	2[a]		1	3	2	1	1	0	8
	3[a]		1	2	3	0	1	1	8
	4[a]	2[b]	0	0	2	1	2	1	6
	5[a]		0	1	0	3	3	0	7
	6[a]		0	0	1	1	4	0	6
	Total		6	8	9	6	11	2	42

[a] Responses of original scale are 1: completely agree, 2: agree, 3: slightly agree, 4: slightly disagree, 5: disagree, and 6: completely disagree.

[b] 2 categorized scales which is changed from responses of original scale (6 categorized scales) are 1: agree and 2: disagree

Table 1 Patients' demographics (n=42)

Age (years)		Mean±SD 62.0±10.7 Range 35-79
Sex male:female (women: %)		16:26 (62%)
Number of aneurysms		1.3±0.55 Range 1-3
Size of aneurysms		Median 4mm Range 1.5-25
Aneurysm locations		
	Anterior cerebral aretry	3
	Acom artery	5
	Middle cerebral artery	20
	Internal carotid artery	13
	IC-pcom artery	5
	Vertebral artery	3
	Basilar artery	5
	Total	54
Diagnostic modality for aneurysms		
	MRA 81.0%, 3D-CTA 69.0%, DSA 14.3% (multiple modalities in 86.0%)	
Duration between diagnosis and interview		
	<1 month	5
	1≤ <6 months	17
	6≤ <12 months	7
	12< months	13
Previous subarachnoid hemorrhage		2/42 (4.8%)
Family history		4/42 (9.5%)