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Special Theme Topic: Japanese Surveillance of Neuroendovascular Therapy in JR-NET/JR-NET2—Part I

Detailed Analysis of Puncture Site Vascular Complications in Japanese Registry of Neuroendovascular Therapy (JR-NET) and JR-NET2

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Abstract

A subgroup analysis of access site complications in the Japanese Registry of Neuroendovascular Therapy (JR-NET) and JR-NET2, which were retrospective registry studies, was performed. Puncture site vascular complications occurred in 195 (0.63%, mean age: 69.2) of all 31,836 patients. Most of these complications resulted from surgery in main hospitals (186 patients, 0.67%, P < 0.001) and scheduled surgery (167 patients, 0.73%, P < 0.001). Carotid artery stenting (81 patients, 1.04%, p < 0.001), extracranial percutaneous transluminal angioplasty (PTA) (15 patients, 1.02%, p < 0.001), and intracranial PTA (10 patients, 0.81%, p < 0.05) were associated with significantly higher incidence of complications. The incidence of puncture site vascular complications was correlated with the number of antiplatelet drugs (p < 0.001) and intraoperative heparinization (p < 0.05).

Key words: puncture site vascular complication, endovascular treatment, nationwide survey

Introduction

Access site complications occurred in 3.1–9.7% of patients who underwent neuroendovascular therapy.[1)] Retroperitoneal hematoma, in particular, may result in death due to massive bleeding. In recent years, hemostatic devices have been developed and improved with efficacy shown in many meta-analyses, but retroperitoneal hematoma still requires much caution.[1–4)] The Japanese Registry of Neuroendovascular Therapy (JR-NET) and JR-NET2 were retrospective registry studies of neuroendovascular therapy conducted by the Japanese Society for Neuroendovascular Therapy in Japan. JR-NET was conducted from January 2005 to December 2006, and JR-NET2 was conducted from January 2007 to December 2009. The registration parameters included disease-specific parameters and cross-sectional parameters common to all diseases. In this article, access site complications, a cross-sectional registration parameter in JR-NET and JR-NET2, are analyzed.

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Materials and Methods

Of 11,114 patients in JR-NET and 20,854 patients in JR-NET2, a total of 31,836 evaluable patients with data on complications (JR-NET: 11,085, JR-NET2: 20,751) were included in the evaluation. Access site complications included hemorrhagic complications, ischemic complications, and infection. The hemostatic method, which was not described, was not assessed. The presence or absence of access site complication, age, sex, facility (main hospital or satellite hospital), timing of surgery (scheduledor emergency), investigator (supervisor, specialist, or non-specialist), treatment (cerebral aneurysm embolization, anteriovenous

malformation embolization, spinal lesion, dural arteriovenous fistula, intracranial tumor, carotid artery stenting, extracranial percutaneous transluminal angioplasty [PTA], intracranial PTA, acute recanalization therapy, spasm treatment, or other), outcome of complication (asymptomatic, transiently symptomatic, moderately disabled, severely disabled, or dead), and effect of complication on the outcome of treatment (unrelated, possibly related, probably related, or related) were assessed.

Of patients who received treatment (cerebral aneurysm embolization, carotid artery stenting, extracranial PTA, and intracranial PTA) with a question about antiplatelet therapy as a registration parameter, 21,489 patients with available data were included in the assessment of preoperative use of antiplatelet drugs. In addition, a total of 22,234 patients who received treatment (cerebral aneurysm embolization and acute recanalization therapy) with a question about heparin as a registration parameter and who underwent carotid artery stenting, extracranial PTA, and intracranial PTA for which heparinization is generally recommended in the relevant guidelines and were thus assumed to have received heparin were included in the assessment of intraoperative heparinization.

These variables were analyzed using chi-square test for categorical variables and *t*-test for continuous variables, with a significance level of $p < 0.05$. SPSS Ver.21 (IBM, Armonk, New York, USA) was used for statistical analysis.

Results

Access site complications occurred in 195 (0.63%) of all 31,836 patients (Table 1). Significantly more of these complications resulted from surgery in main hospitals (186 patients, 0.67%, $p < 0.001$) and scheduled surgery (167 patients, 0.73%, $p < 0.001$). The incidence of complications was not different depending on the investigator's experience (non-specialist, specialist, or supervisor).

By treatment, carotid artery stenting (81 patients, 1.04%, $p < 0.001$), extracranial PTA (15 patients, 1.02%, $p < 0.001$), and intracranial PTA (10 patients, 0.81%, $p < 0.05$) were associated with a significantly higher incidence of complications, and tumor embolization (1 patient, 0.06%, $p < 0.05$) was associated with a significantly lower incidence.

The outcome of treatment was asymptomatic or transiently symptomatic in 83.59%, permanently disabled in 18 patients (0.06%), and fatal in 2 patients (0.006%).

Use of antiplatelet drugs by treatment is shown in Table 2 and Fig. 1. Of patients who underwent aneurysm embolization, the majority used none (47.78%), and 25.16% and 22.39% used 1 and 2 drugs, respectively. On the other hand, approximately 10%, 68.2–78.2%, and 5.0–8.3% of patients who underwent carotid artery stenting, extracranial PTA, or intracranial PTA used 1, 2, and 3 drugs, respectively, with few receiving none (0.4–10.5%). The incidence of access site complications by use of antiplatelet drugs is shown in Fig. 2. The incidence was significantly different among patients receiving none (21 patients, 0.34%), those receiving 1 or 2 drugs (122 patients, 0.84%), and those receiving 3 or more drugs (18 patients, 2.25%), with the highest incidence in those receiving 3 or more drugs.

The incidence of access site complications in the presence or absence of heparinization is shown in Fig. 3. In all patients, the incidence was significantly different between heparinized patients (175 patients, 0.79%) and non-heparinized patients (3 patients, 0.22%) ($p < 0.05$). In patients who underwent aneurysm embolization ($p = 0.22$) and acute recanalization therapy ($p = 0.07$), the incidence was not significantly different with or without heparinization. In heparinized patients, the incidence of access site complications was significantly higher in patients who underwent carotid artery stenting (81 patients, 1.08%, $p < 0.001$) or extracranial PTA (13 patients, 1.03%, $p < 0.05$) than in those who underwent aneurysm embolization (65 patients, 0.56%).

Discussion

In this study, the incidence of access site complications was 0.63%, which is substantially lower than previously reported 3.1% to 9.7%.[1,2,5] This may be in part because the puncture site vascular complication was not very clearly defined in the present study and there may have been unreported mild cases.

Scheduled surgery resulted in a higher incidence of access site complications than emergency surgery, although opposite results were reported in a study of cardiac catheterization using hemostatic devices.[6] This may be because the number of patients who underwent scheduled surgery and emergency surgery was imbalanced, and carotid artery stenting, extracranial PTA, and intracranial PTA, which have a higher risk of puncture site vascular complications, were largely performed as scheduled surgery.

While there were no differences in experience among surgeons, no detailed assessment was made because data on which surgeons were actually involved in puncture or hemostasis were not available.

By treatment, carotid artery stenting, extracranial PTA, and intracranial PTA were associated with higher incidence of complications. This may be partly explained by intraoperative heparinization

Table 1 Charactaristics of puncture site vascular compilications

	Total	Puncture site complication (%)	% in access site complication	Data unavailable	P value
Case	31,836				
Age (± SD)	63.73 ± 13.81 (0–104)				
All complication	2,640 (8.29)	195 (0.63)			
Background					
Age ± SD (range)	69.22 ± 11.35 (15–89)				NS
Male	16,944	94 (0.55)	48.21		NS
Facility				1	< 0.001
Main hospital	27,794	186 (0.67)	95.38		
Satellite	4,019	8 (0.20)	4.10		
Operation time				0	< 0.001
Schedule	22,743	167 (0.73)	85.64		
Emergency	9,037	28 (0.31)	14.36		
Operator				0	NS
Supervisor	16,705	95 (0.57)	48.22		
Specialst	12,686	80 (0.63)	40.61		
Non-specoalist	2,366	20 (0.85)	10.15		
Treatment				0	< 0.001
Cerebaral aneurysm embolization	13,019	67 (0.51)	34.36		NS
Arterio-venous malformation	986	1 (0.10)	0.51		NS
Spinal lesion	196	0	0.00		NS
Dural AVF	2,230	5 (0.22)	2.56		NS
Tumor	1,736	1 (0.06)	0.51		< 0.05
Carotid artery stent	7,818	81 (1.04)	41.54		< 0.001
Entercranial PTA	1,476	15 (1.02)	7.69		< 0.001
Intracranial PTA	1,235	10 (0.81)	5.13		< 0.05
Acute recanalization therapy	1,410	9 (0.64)	4.62		NS
Spasm treatment	645	1 (0.16)	0.51		NS
Others	1,085	5 (0.22)	2.56		NS
Outcome				12	
Asymptomatic		84	43.08		
Traniently symptomatic		79	40.51		
Modrate disabled		11	5.64		
Sever disabled		7	3.59		
Dead		2	1.03		
Influence of complication				12	
Unrelated		92	47.18		
Possible related		3	1.54		
Probable related		0	0.00		
Related		88	45.13		

AVF: arteriovenous fistula, NS: not significant, PTA: percutaneous transluminal angioplasty, SD: standard deviation.

Table 2 Use of antiplatelet drugs by treatment

	0		1 drug		2 drugs		More than 3 drugs	
	n (%)	Complication (%)	n (%)	Complication (%)	n (%)	Complication (%)	n (%)	Complication (%)
Total (n = 21,489)	6,131 (28.5)	21 (0.34)	4,449 (20.7)	36 (0.81)	10,110 (47.0)	86 (0.85)	799 (3.7)	18 (2.25)
Aneurysm (n = 11,872)	5,932 (50.0)	19 (0.32)	3,124 (26.3)	22 (0.70)	2,780 (23.4)	21 (0.76)	36 (0.3)	1 (2.79)
Carotid artery stent (n = 7,259)	31 (0.4)	1 (3.2)	949 (13.1)	9 (0.95)	5,677 (78.2)	54 (0.95)	602 (8.3)	14 (2.32)
Extracranial PTA (n = 1,232)	49 (4.3)	0	236 (20.9)	3 (1.27)	885 (78.2)	7 (0.79)	62 (5.5)	2 (3.23)
Intracranial PTA (n = 1,126)	119 (10.6)	1 (0.84)	140 (12.4)	2 (1.42)	768 (68.2)	4 (0.52)	99 (8.8)	1 (1.01)

PTA: percutaneous transluminal angioplasty.

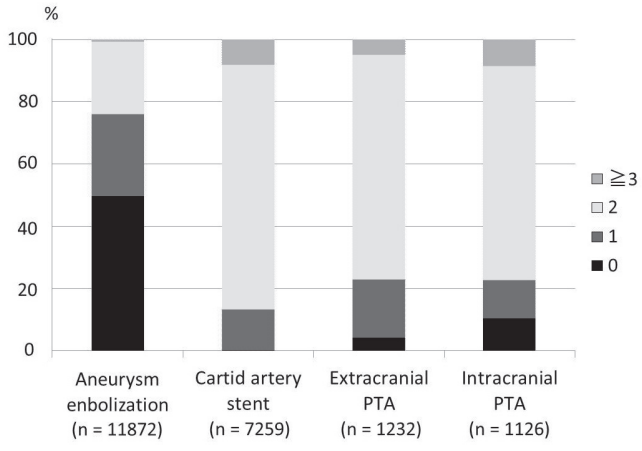

Fig. 1 Use of antiplatelet drugs by treatment. PTA: percutaneous transluminal angioplasty.

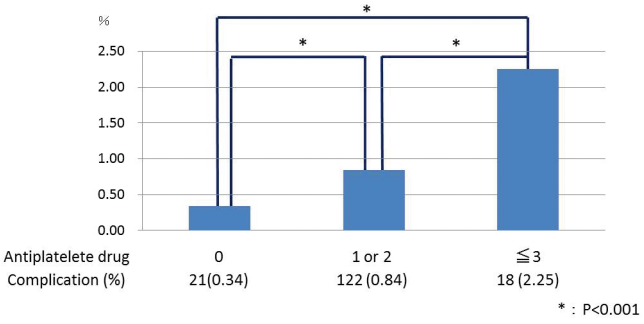

Fig. 2 Univariate analysis of status of antiplatelet agents. The incidence of access site complications was significantly different between patients receiving 3 antiplatelet drugs and those receiving 1 or 2 drugs, between those receiving 1 or 2 drugs and those receiving none, and between those receiving 3 drugs and those receiving none. PTA: percutaneous transluminal angioplasty.

and preoperative use of multiple antiplatelet drugs. It may also be accounted for frequent use of tools with a wide diameter such as sheath size.

The outcome of treatment was asymptomatic or transiently symptomatic in 83.5%, but disabled in 9.2%. Death-related access site complications occurred in 2 patients (0.006%), but these patients had not only access site complications, but also other complications (ischemic and hemorrhagic complications). The outcome of treatment was not related to access site complications in half of the cases and was related only in the remaining half. In this study, whether the outcome of treatment was affected by access site complications cannot be definitively concluded, because some patients had not only access site complications, but also other complications.

As for the limitations of the study, it was a retrospective registry study, and there were many patients with incomplete data entry. A low incidence of access site complications in satellite hospitals might have reflected incomplete data entry. In addition, the dose of heparin was not described, but statistical analysis

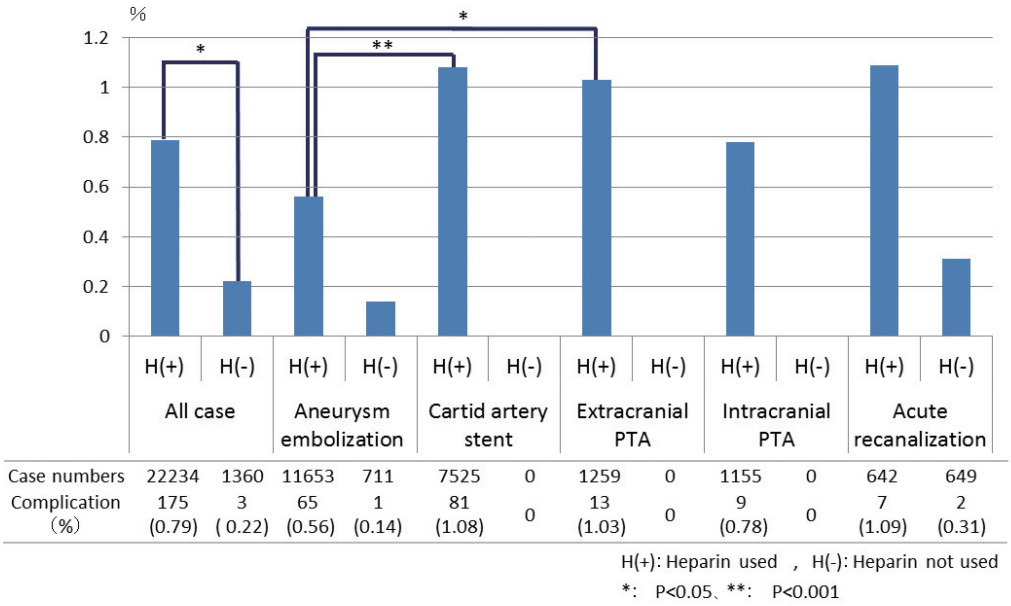

Fig. 3 Univariate analysis of effect of using heparin in each treatment. The incidence of access site complications was significantly different between heparinized patients and non-heparinized patients, between heparinized patients who underwent aneurysm embolization and heparinized patients who underwent carotid artery stenting, and between heparinized patients who underwent aneurysm embolization and heparinized patients who underwent extracranial PTA. PTA: percutaneous transluminal angioplasty

was performed on the assumption that heparin was used in patients who underwent angioplasty, possibly generating a bias. The hemostatic method was also not described.

Conclusion

The incidence of puncture site vascular complications was 0.63%. These complications resulted in permanent disability in 18 patients (0.06%) and death in 2 patients (0.006%). Carotid artery stenting, extracranial PTA, intracranial PTA, heparinization, and use of antiplatelet drugs were associated with higher incidence of complications. In particular, use of multiple antiplatelet drugs was associated with an increased risk, requiring caution.

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Conflicts of Interest Disclosure

The authors declare no conflicts of interest. All authors who are members of The Japan Neurosurgical Society (JNS) have registered online Self-reported COI Disclosure Statement Forms through the website for JNS members.

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