

뇌동정맥기형의 수술합병증 : 297예의 후향적 분석

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Surgical Complications of Cerebral Arteriovenous Malformation : A Retrospective Analysis of 297 Consecutive Cases

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ABSTRACT

To analyze the complications following surgical resection of cerebral arteriovenous malformations (AVMs) and to improve the surgical outcomes, we reviewed 297 consecutive patients who had undergone surgical excision of AVM at Yonsei University between June 1975 and July 2004. The patients' ages ranged from 2 to 68 with a mean age of 29 years. The series included 182 males (61.3%) and 115 females (38.5%). The most common presenting symptom was hemorrhage (228 patients, 76.8%). And others were seizure (45 patients, 15.2%), hemorrhage with seizure (12 patients, 4.1%), focal deficit (3 patients, 1.0%), headache (4 patients, 1.3%) and incidental (5 patients, 1.6%). The locations of AVMs were cerebral convexity (220 patients, 74% : 46 frontal, 68 parietal, 77 temporal, 29 occipital), callosal (28 patients, 9.4%), sylvian (11 patients, 3.7%), rolandic (8 patients, 2.7%), basal ganglia and thalamus (11 patients, 3.7%), cerebellum (18 patients, 6.1%) and one patient had brain stem lesion (0.3%). Postoperative rebleeding and the incomplete excision (12 and 9 patients each) were the major surgical complications, followed by postoperative epilepsy (5 patients), normal perfusion pressure breakthrough (3 patients), and infection (2 patients). The outcome was classified into good for the patients who returned to their previous jobs with or without neurological deficits, fair for the patients who were unable to return to work but performed daily activities independently with minor deficits, and poor for the patients who were performing dependent daily activities with major deficits. The average follow-up period was 4.2 years. The overall outcome of surgery was considered good in 233 patients (75.0%), fair in 51 patients (17.2%), poor in 15 patients (5.1%) and 8 patients (2.7%) were died. The Spetzler-Martin grading system correlated well with the difficulty of surgery. No morbidity resulted from resection of Grade I AVMs ; the percentage with unfavorable outcome was 8.1% in Grade II, 9.6% in Grade III, and 28.6% for those with Grade IV. Initial insult (14 patients) and rebleeding (4 patients) were the major causes of unfavorable outcome. Prevention of postoperative hemorrhage following meticulous hemostasis and complete excision and prevention of hemodynamic complications would result in a favorable outcome after surgery for cerebral AVM. (Kor J Cerebrovascular Surgery 6:50-7, 2004)

KEY WORDS : Arteriovenous malformation · Surgical complication · Unfavorable outcome.

서 론

. 1951 Basset
5)

3% 30%, 0% 12.5%
2)10)15)16)18)23)24)34)37)

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. Wilson
6% 18
2
5 16

Steinmeir 44% 114 가 10)12)
 6 3% 1 : 1.6
 33) 2 68 (29) (Table 2).

대상 및 방법

1975 6 2004 7 297
 가 283 (95.3%) , 가
 52 (18.2%)
 가 10 (3.4%), 가
 가 3 (1.0%),
 가 1 (0.3%) (Table 1).
 297

Spetzler - Martin grade

(unfavorable outcome)
 가
 (Good),
 (Fair),
 (Poor)

결 과

1. 연령 및 성별

297 183

Table 1. Treatment modalities for cerebral AVM (n=297)

Modality	No. of case (%)
Microsurgery	283 (95.3)
Microsurgery after radiosurgery	3 (1.0)
Radiosurgery after microsurgery	10 (3.4)
Combined [†]	1 (0.3)
Total	297 (100.0)

† Combined : embolization+radiosurgery+microsurgery
 preoperative embolization rate : 18.2%

2. 발현증상, 기형의 위치, Spetzler-Martin grade

228 (76.8%) 가 ,
 45 (15.2%)
 가 12 (4.1%) . 3
 (1.0%), 4 (1.3%), 가 5 (1.6%)
 77 (25.9%) 가
 68 (22.9%), 46
 (15.5%), 29 (9.8%), 28 (9.4%),
 18 (6.1%), 11 (3.7%), - 11
 (3.7%), Rolandic 8 (2.7%), 1 (0.3%)

Spetzler - Martin

grading system Grade 가 124 (41.8%)
 가 , Grade 가 94 (31.6%), 65
 (21.9%), 14 (4.7%) . Grade 가

3. 수술 결과

297 264 (88.9%)
 , 14 (4.7%) , 16 (5.4%)
 , 3 (1.0%)
 (Table 3).

4. 치료 예후

223 (75.0%) , 51
 (17.2%) , 15 (5.1%) 8 (2.7%)
 가 162 가

Table 2. Age and sex distribution (n=297)

Age	Male	Female	Total (%)
<20	50	32	82 (27.6)
20 - 39	92	61	153 (51.5)
40 - 59	35	18	53 (17.9)
>= 60	5	4	9 (3.0)
Total (%)	182 (61.3)	115 (38.7)	297 (100.0)

Table 3. Surgical resectability

Resectability	Number	%
Total resection	264	88.9
Subtotal resection	14	4.7
Partial resection	16	5.4
Exploration	3	1.0
Total	297	100.0

Table 4. Presentations and outcomes (n=297)

Presentation	No. of patients				
	Good	Fair	Poor	Dead	Total
Hemorrhage	162 (71.0)	45 (19.8)	13 (5.7)	8 (3.5)	228 (76.8)
Seizure	41 (91.1)	3 (6.7)	1 (2.2)	-	45 (15.2)
Mixed†	9 (75.0)	2 (16.7)	1 (8.3)	-	12 (4.1)
Focal deficit	3 (100.0)	-	-	-	3 (1.0)
Headache	4 (100.0)	-	-	-	4 (1.3)
Incidental	4 (83.3)	1 (16.7)	-	-	5 (1.6)
Total	223 (75.0)	51 (17.2)	15 (5.1)	8 (2.7)	297 (100.0)

† Mixed:hemorrhage with seizure

Table 5. Locations of AVMs and outcomes

Location	Overall outcome (%)				
	Good	Fair	Poor	Dead	Total
Cerebral convexity					
Frontal	39 (84.8)	5 (10.9)	2 (4.3)	-	46 (15.5)
Parietal	52 (76.4)	11 (16.2)	4 (5.9)	1 (1.5)	68 (22.9)
Temporal	56 (72.7)	14 (18.2)	4 (5.2)	3 (3.9)	77 (25.9)
Occipital	23 (79.3)	3 (10.3)	1 (3.5)	2 (6.9)	29 (9.8)
Callosal	22 (78.6)	5 (17.9)	1 (3.5)	-	28 (9.4)
Sylvian/insular	9 (81.8)	2 (18.2)	-	-	11 (3.7)
Rolandic	7 (87.5)	-	1 (12.5)	-	8 (2.7)
Thalamus/basal ganglia	4 (36.3)	5 (45.5)	1 (9.1)	1 (9.1)	11 (3.7)
Cerebellum	11 (61.1)	5 (27.7)	1 (5.6)	1 (5.6)	18 (6.1)
Brain stem	-	1 (100.0)	-	-	1 (0.3)
Total	223 (75.0)	51 (17.2)	15 (5.1)	8 (2.7)	297 (100.0)

Table 6. Spetzler-Martin grade and related outcomes

S-M grade	Overall outcome (%)				
	Good	Fair	Poor	Dead	Total
I	58 (89.2)	7 (10.8)	-	-	65 (21.9)
II	93 (75.0)	21 (16.9)	7 (5.6)	3 (2.5)	124 (41.8)
III	64 (68.1)	21 (22.3)	4 (4.3)	5 (5.3)	94 (31.6)
IV	8 (57.1)	2 (14.3)	4 (28.6)	-	14 (4.7)
Total	223 (75.0)	51 (17.2)	15 (5.1)	8 (2.7)	297 (100.0)

Average follow-up period : 4.2 years

가(71.0%), 45 (19.8%), 13 (5.7%) 8 (3.5%) 가 . (Table 5). Spetzler - Martin grade 65 가 58 41 (91.1%), 3 (6.7%), (89.2%), 7 (10.8%) , grade 124 1 (2.2%) . 가 93 (75.0%), 21 (16.9%), 7 (5.6%) 3 가 (2.5%). (Table 4). Grade 94 가 64 (68.1%), 21 (22.3%), 4 (4.3%), 5 (5.3%) grade 14 8 (57.1%), 2 (14.3%), 4 (28.6%) grade - 가 (36.3%) 가 , 가 18.2%

Table 7. Major complications of AVM resection in 297 surgical cases

Complication	No. of patients
Rebleeding	12
Remnant	9
Seizure	5
NPPB	3
Infection	2
Systemic	2
EDH	1
Ruptured aneurysm	1
Total	35 (11.8%)

Table 8. Causes of unfavorable outcomes

	Outcome		
	Poor	Dead	Total
Initial insult	11	3	14
Rebleeding	3	1	4
Radiation necrosis	1	-	1
Systemic complication	-	2	2
NPPB [†]	-	1	1
Ruptured aneurysm	-	1	1
Total	15 (5.1%)	8 (2.7%)	23 (7.8%)

† : Normal perfusion pressure breakthrough

(Table 6).

Grade V

5. 수술 합병증 및 불량 예후의 주요원인

35 (11.8%)

12 가 , 9

3 , 9

4 가

5 , 3 , 2 ,

1 .

2 , 1 (Table 7).

5.1%

(15), 2.7%(8) . 15

3

3 ,

가 1

8

가 가 3 가 ,

가 2 ,

1 , 1

가 1 (Table 8).

고찰

steal phenomenon
(chronically hypoperfused brain tissue) 가

breakthrough(NPPB), normal perfusion pressure 가

Jomin
40%
2%¹⁷⁾

Drake 140
가 106 4.8% 5.7%

32% 31%

⁸⁾

, Pia

43

29

85%(22)

²⁷⁾

23

14 (60.9%)

가

²⁰⁾²¹⁾³³⁾ 1986 Spetzler Martin

100

grading system

³¹⁾

grade ,

grade

4%, grade

7% grade V

12%

. Heros 371

grade , , V

(morbidity 2.8/20.3%, mor-

tality 0.4/1.6%).¹⁵⁾

grade

가 , grade

5.3%

, grade 28.6%

. Shi Chen

100 (optic radiation)

3 1% 13%

(nidus)

³⁰⁾ Batjer 1983

1986 62

11%, 7%

가 가 가 (packing)

3 cm 5%, 3~6 cm

15% 6 cm 35% (subependymal arteriole) (venule)

가 Pertuiset

steal 40 cc

⁶⁾ Morgan Spetzler - Martin grade (pericallosal artery),

lenticulostriate

²¹⁾ 가 , eloquent area ²⁶⁾

, high flow lesion, 8 cm

, lenticulostriate

, spring clip

가

(oozing)

가

tic plane gli- silver clip 가

(transit artery) 가 가

가 sulci 9 가 12

(9.1%) (9.1%) (9.1%)

non - eloquent area 가 (diffuse)

(bridging vein) 가

가

1.8% . Hoh 324 hippocampus CA1 pyramidal cell region 26
 foot process
 protocol 가
 (artifact) 16) 가 29)
 1~3% Yasargil
 (carotid - jugular fistula) gil 440 29)
 "steal" (carotid - jugular fistula) 200 2 NPPB 37) Heros
 pCO2 15)
 28)32)
 가 30% , Yasargil 가
 , Spetzler 1978 가 가
 "the-
 ory of normal perfusion pressure breakthrough"
 32) Pertuiset "vasogenic turgescence of the
 brain" 가 가 가 ,
 26)
 shunting 3 1~2
 가 295 2) AI - Rodhan
 12% 34 가 가
 Hassler Gilsbach 35 19 19 가 14
 12 NPPB 가
 artery) (pial 가
 14) circle of Willis 3)
 가 가 , 가 ,
 8 cm "steal"
 NPPB 1 watershed zone 가 , turbulent flow
 NPPB가 shearing stress
 "steal" 가
 가
 가
 가
 50% 6.5%
 Pelletieri 11) Guidetti 6.5%
 7.2% 13)25) Yasargil 227

32 (11.6%)
 27
 (12%)
 37) Abad 58 7
 5
 1) Murphy 30
 3.5
 22)
 가 Foster 18%
 10) Jomin
 32
 17) Guidetti 55.8%
 13) Pelletieri 86.1%
 25)
 5
 가
 가
 가
 가
 And-
 rews Wilson 13 large, high - flow AVM
 NPPB 9 complex AVM
 10.7%
 4) Drake, Faria
 8)9)
 Debrun
 7) 가
 Luessenhop 55 3
 19) Drake Gelfoam
 3 8) Kvam Si-
 lastic spheres 157 2
 18) Vinuela bucrylate
 64 4 3

35)
 , large high - flow AVM 가

결론

, gliotic plane
 가

중심 단어 :

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