

자발성 뇌지주막하 출혈 환자에서 뇌동맥류 검출에 대한 고식적 혈관조영술과 3차원 전산화 단층 혈관조영술의 비교*

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= Abstract =

Detection of Aneurysms in Patients with Spontaneous Subarachnoid Hemorrhage : A Comparison of Three-dimensional Computed Tomographic Angiography and Conventional Angiography

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Objectives : Three - dimensional computed tomographic angiography(3D - CTA) is recently developed diagnostic imaging modality. We have studied this noninvasive method for possible role in replacing conventional angiography(CA) in the detection of aneurysms of the circle of Willis in patients with subarachnoid hemorrhage(SAH).

Methods : We studied retrospectively, the 100 patients with SAH or unruptured aneurysms admitted to our hospital from October 1997 to December 1998. Among there, 85 patients underwent CTA, 82 patients underwent CA and 67 patients underwent both of CTA and CA. 3D - CTA was obtained using maximum intensity projection(MIP) and shaded - surface display(SSD) reconstruction.

Results : Total 107 aneurysms were detected in 92 patients, and 64 aneurysms were detected in 67 patients underwent both CTA and CA. In five cases of those 67 cases, aneurysms were detected by CA but not by 3D - CTA. The detection rate of aneurysms(91.8%) and the detection rate of parent artery in cases of anterior communicating artery aneurysms(86.9%) with total 3D - CTA were relatively compatible with that of CA. But 3D - CTA was not enough in detection of posterior communicating artery aneurysms, internal carotid artery aneurysms as well as small sized aneurysm(<3mm).

Conclusion : We consider CTA is valuable in as a screening test for cerebral aneurysm and follow - up test. And it is also valuable in early surgery for patients with aneurysmal rebleeding because of simple, quick, non - invasive method.

KEY WORDS : Aneurysm · Spiral CT angiography · Conventional angiography.

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서 론

ventional angiography, CA) (conv- 가 (spiral computed tomo- graphy) 3 (three - dimensional computed tomographic angiography, 3D - CTA) 가

1999

CA
3D-CTA
(screening test)
대상 및 방법
1. 연구 대상
1997 10 1998 12
CT
가 3D-CTA
100 23
77 (53) 36 ,
64 1 : 1.8 (Table 1).
3D-CTA CA
3D-CTA
18 , CA 15 3D-
CTA CA 67 (Table 2).
가
3D-CTA CA 67 1 3D-
CTA 18 1 가

Table 1. Age distribution of patients

Age	Numbers
20 - 29	1
30 - 39	17
40 - 49	25
50 - 59	26
60 - 69	24
70	7
Total	100

3D-CTA 85 0~1
CA 82 12 1 (day 0),
57 1~3 , 12 4~14 , 1 2
100 Hunt - Hess Grade 13 , 가
27 , 가 34 , 가 16 , 가 8
가 Grade 0
가 2 Fisher Grade 11 , 가 14 ,
가 42 , 가 33
2. 방 법
3D-CTA CT (Hispeed CT/i, GE Medical
System, Milwaukee, USA)
(topogram) (superior
orbitomeatal line) (sella turcica)
DFOV
(Display Field Of View) 15cm, (matrix)
512 x 512, 120kV, 200mA
(antecubital vein) 18G
120~150ml
(Omnipaque, 300mg/ml) (power in-
jector, MEDRAD, EnVisionCT) 3.5ml
13~18
(circle of Willis) (table feed
speed) 1.5mm/sec, CT (section thickness)

Table 2. Numbers of patients of computed tomographic angiography(CTA) and conventional angiography(CA)

	Total CTA	Total CA	CTA+CA	Only CTA	Only CA
Male(n=36)	32	30	26	6	4
Female(n=64)	53	52	41	12	11
Total(n=100)	85	82	67	18	15

n : number of cases

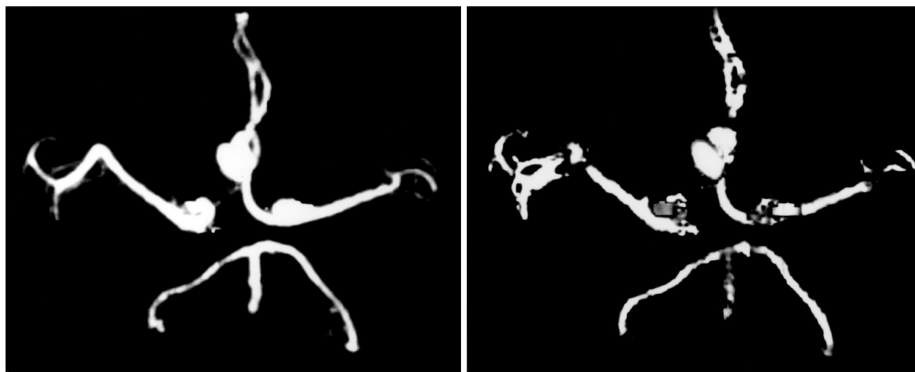


Fig. 1. The left is MIP(Maximum Intensity Projection) and the right is SSD(Shaded-Surface Display).

1mm, 35mm, 0.5 mm, 92, CA, 82, MIP(Maximum Intensity Projection), SSD(Shaded - Surface Display), 3, 가 (Fig. 1).

3. 통계 분석

SPSS 8.0 for Windows, McNemer

결 과

100, 3D-CTA, CA, 가, 92, 8, 90, 92, 107 가, (anterior communicating artery) 26, (posterior communicating artery) 16, (middle cerebral artery) 27, (anterior cerebral artery) 5, (internal carotid artery) 6, (basilar artery) 1, 가, 11, 9, 2, 가, 2, 4, 가, (Table 3).

가, 92, 2mm, 26mm, <3mm, 가 4, 3~6mm가 33, 7~10mm가 42, 11~25mm가 12, >25mm 1 (Table 4).

Table 3. Location of the aneurysms

Location	Numbers of patients
A-com	26
P-com	16
MCA	27
ACA	5
ICA	6
V-B	1
Multiple	11
Non-AN	8
Total	100

A-com : anterior communicating artery
P-com : posterior communicating artery
MCA : middle cerebral artery
ICA : internal carotid artery
V-B : vertebro-basilar artery
Non-AN : no aneurysm

92, CA, 82, 78, 95.1% (78/82), 3D-CTA, 85, 78, 5, 3D-CTA, 가, 73, 가, 85.9% (73/85), 3D-CTA, CA, 67, 64, 가, 95.5%(64/67), 64, 59, 3D-CTA, CA, 가, 가 CA, 3D-CTA, (Table 5), 3D-CTA, 가, 5, 3, 가, 3mm, 2, 가 1, 2, 3~6mm, 가 1, 3~6mm, 30ml, 3, 3D-CTA, CA, 67, CA, 가, 64, 3D-CTA, 59, CA, 64, 52, 81.3%(52/64), 3D-CTA, 59, 48, 81.4%(48/59)

Table 4. Size of aneurysms

Size	Numbers
<3 mm	4
3 - 6 mm	33
7 - 10 mm	42
11 - 25 mm	12
>25 mm	1
Total	92

Table 5. Rate of detection of aneurysms

	Total CTA	Total CA	CTA + CA	Only CTA	Only CA
No. of Total cases(n=100)	85	82	67	18	15
No. of aneurysmal cases (n=92)	78	78	64		
detect in CA		78			14
detect in CTA	73		59	14	
no detect in CTA	5		5		
Non-aneurysm(n=8)			3	4	1

CTA : computed tomographic angiography
CA : conventional angiography
Non-aneurysm : no aneurysm

Table 6. Location of the aneurysms and delineation of the aneurysmal neck*

Location	CA		3D-CTA	
	Detection of aneurysm	Detection of aneurysmal neck	Detection of aneurysm	Detection of aneurysmal neck
A-com(n=26)	19	16	19	15
P-com(n=16)	13	9	10	8
MCA(n=27)	17	13	15	13
ACA(n=5)	5	5	5	5
ICA(n=6)	4	4	4	3
Multiple(n=11)	6	5	6	4
Total(n=92)	64	52	59	48

* : In the aneurysmal 64 patients of 67 patients underwent both 3D-CTA and CA
 CTA : computed tomographic angiography
 CA : conventional angiography

Table 7. Detection of aneurysm and parent artery of anterior communicating artery(n=26)

A-com	Total CTA	Total CA	CTA + CA	Only CTA	Only CA
Detection of aneurysm	23	22	19	4	3
Detection of parent artery	20	22	16	4	3

CTA : computed tomographic angiography
 CA : conventional angiography
 A-com : anterior communicating artery

가 (Table 6).

26
 3D - CTA 23 20
 (parent artery, A1) MRA)
 가 86.9%(20/23) 3
 3D - CTA , A1
 가 CA (Table 7).
 92 3D - CTA 18
 CA
 14 가 가 가
 가 3 가
 1 3D - CTA
 CA CTA
 McNemer (p=0.063).
 3D - CTA
 가 CT 3 CT 1
 가 . 3D - CTA 3

CT
 13)
 CA가
 0.1~2.6%
 6 CA 가 가
 가 가 4)
 CA
 7.1%
 3)4)6)18)20)21)
 (magnetic resonance angiography,
 MRA)
 26) MRA
 (turbulent flow)
 가 가 가
 가 가
 (indwelling electrical
 device, or ferromagnetic intracranial clip)
 1)8)12)21)28)

고 찰

3D - CTA (volumetric data acquisition)
 가 CT 3 CT 1
 가 . 3D - CTA 3

3D - CTA가 CA
 2)8)11)14)26)
 Dixon
 Brown⁵⁾ 가
 CA 가
 Hope¹⁰⁾ 3D - CTA
 CA
 Dendy⁷⁾ CT 10
 CT 10

MIP(Maximum Intensity Projection)
 SSD(Shaded - Surface Display)

MIP 가 SSD 2 가 CA
 가 10mm 가 3D - CTA
 6)9)19)

15)19)28) 가
 CA 3D - CTA CT 14 CA
 Dillon⁶⁾
 3D - CTA가

90% 10)12)15)25)28)
 3D - CTA 91.
 8% CA 95.5%

결 론

26 3D - CTA CA
 3D - CTA 23 86.9%(20/23) 3D - CTA CA
 CA 3D - CTA

가 3mm 3D - CTA
 가 CT
 가 2)21)23)24)28)
 3D - CTA 가 3mm
 2

1) 장 점 :

- (1)
- (2) CA
- (3) CA
- (4)

1 CA 가 3mm CA가
 가 3D - CTA

(5) (screening test)

(6)

가 3mm 2
 가 3~6mm
 (paraclinoid)

2) 단 점 :

- (1)
- (2) 가 3mm
- (3)

가 CA가
 3D - CTA

3D - CTA 3D - CTA가 CA 가 CA
 CA
 (infundibular dilatation)
 가 CA가 Preda
 20)

- : 2000 5 22
 - : 2000 12 5
 - :
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References

- 1) Alberico RA, Patel M, Casey S, Jacobs B, Maguire W, Decker R : *Evaluation of the Willis with three-dimensional CT angiography in patients with suspected intracranial aneurysms. AJNR 16 : 1571-1578, 1995*
- 2) Anderson GB, Findlay JM, Steinke DE, Ashforth R : *Experience with computed tomographic angiography for the detection of intracranial aneurysms in the setting of acute subarachnoid hemorrhage. Neurosurgery 41 : 522-528, 1997*
- 3) Aoki S, Sasaki Y, Machida T, Ohkubo T, Minami M, Sasaki Y : *Cerebral aneurysms : Detection and delineation using 3-D-CT angiography. AJNR 13 : 1115-1120, 1992*
- 4) Baxter AB, Cohen WA, Maravilla KR : *Imaging of intracranial aneurysms and subarachnoid hemorrhage. Neurosurg Clin N Am 9 : 445-462, 1998*
- 5) Brown JH, Lustrin ES, Lev MH, Ogilvy CS, Taveras JM : *Characterization of intracranial aneurysms using CT angiography. AJR 169 : 889-893, 1997*
- 6) Dillon EH, van Leeuwen MS, Fernandez MA, Mali WPTM : *Spiral CT angiography. AJR 160 : 1273-1278, 1993*
- 7) Dixon AK, Dendy P : *Spiral CT : How much does radiation dose matter? Lancet 352 : 1082-1083, 1998*
- 8) Dorsch NW, Young N, Kingston RJ, Compton JS : *Early experience with spiral CT in the diagnosis of intracranial aneurysms. Neurosurgery 36 : 230-238, 1995*
- 9) Gosselin MV, Vieco PT : *Active hemorrhage of intracranial aneurysms : Diagnosis by CT angiography : Case Report. J Comput Assist Tomogr 21 : 22-24, 1997*
- 10) Hope JK, Wilson JL, Thomson FJ : *Three-dimensional CT angiography in the detection and characterization of intracranial berry aneurysms. AJNR 17 : 439-445, 1996*
- 11) Hsiang JN, Liang EY, Lam JM, Zhu XL, Poon WS : *The role of computed tomographic angiography in the diagnosis of intracranial aneurysms and emergent aneurysm clipping. Neurosurgery 38 : 481-487, 1996*
- 12) Katz DA, Marks MP, Napel SA, Bracci PM, Roberts SL : *Circle of Willis : Evaluation with spiral CT angiography, MR angiography, and conventional angiography. Radiology 195 : 445-449, 1995*
- 13) Kim BJ, Kim YH, Seo JJ, Chong JY, Kim JK, Park JG, et al : *Usefulness of angiography in patients with intracranial occlusive vascular disease of the circle of Willis : Comparison with conventional angiography. J Korean Radiol Soc 35 : 301-306, 1996*
- 14) Lenhart M, Bretschneider T, Gmeinwieser J, Ullrich OW, Schlaier J, Feuerbach S : *Cerebral CT angiography in the diagnosis of acute subarachnoid hemorrhage. Acta Radiol 38 : 791-796, 1997*
- 15) Liang EY, Chan M, Hsiang JH, Walkden SB, Poon WS, Lam WW, et al : *Detection and assessment of intracranial aneurysm : Value of CT angiography with shaded-surface display. AJR 165 : 1497-1502, 1995*
- 16) Napel S, Marks MP, Rubin GD, Dake MD, McDonnell CH, Song SM, et al : *CT angiography with spiral CT and maximum intensity projection. Radiology 185 : 607-610, 1992*
- 17) Ng SH, Wong HF, Ko SF, Lee CM, Yen PS, Wai YY, et al : *CT angiography of intracranial aneurysms : advantages and pitfalls. Eur J Radiol 25 : 14-19, 1997*
- 18) Park SM, Seo JJ, Kim YH, Jeong YY, Kim JK, Park JG, et al : *Usefulness of 3 dimensional CT angiography in the diagnosis of intracranial aneurysms : comparative study with conventional angiography. J Korean Radiol Soc 34 : 313-319, 1996*
- 19) Preda L, Gaetani P, Rodriguez y Baena R, Di Maggio EM, La Fianza A, Dore R, et al : *Spiral CT angiography and surgical correlation in the evaluation of intracranial aneurysms. Eur Radiol 8 : 739-745, 1998*
- 20) Sekhar LN, Kalia KK, Yonas H, Wright DC, Ching H : *Cranial base approaches to intracranial aneurysms in the subarachnoid space. Neurosurgery 35 : 472-483, 1994*
- 21) Schwartz RB, Tice HM, Hooten SM, Hsu L, Stieg PE : *Evaluation of cerebral aneurysms with helical CT : correlation with conventional angiography and MR angiography. Radiology 192 : 717-722, 1994*
- 22) Strayle-Batra M, Skalej M, Wakhloo AK, Ernemann U, Klier R, Voigt K : *Three-dimensional spiral CT angiography in the detection of cerebral aneurysm. Acta Radiol 39 : 233-238, 1998*
- 23) Tampieri D, Leblanc R, Oleszek J, Pokrupa R, Melancon D : *Three-dimensional computed tomographic angiography of cerebral aneurysms. Neurosurgery 36 : 749-755, 1995*
- 24) Tampieri D, Melancon D, Ethier R : *The role of computed tomographic angiography in the assessment of intracranial vascular disease. Neuroimaging Clin N Am 6 : 759-767, 1996*
- 25) Vieco PT, Shuman WP, Alsofrom GF, Gross CE : *Detection of circle of Willis aneurysms in patients with acute subarachnoid hemorrhage : A comparison of CT angiography and digital subtraction angiography. AJR 165 : 425-430, 1995*
- 26) Yoon DY, Jang WH, Kim HC, Yi JG, Bae SH, Lee KH, et al : *Comparison of magnetic angiography and CT angiography in the evaluation of intracranial aneurysm. J Korean Radiol Soc 35 : 285-291, 1996*
- 27) Zeman R, Silverman PM, Vieco PT, Costello P : *CT angiography. AJR 165 : 1079-1088, 1995*
- 28) Zouaoui A, Sahel M, Marro B, Clemenceau S, Dargent N, Bitar A, et al : *Three-dimensional computed tomographic angiography in detection of cerebral aneurysms in acute subarachnoid hemorrhage. Neurosurgery 41 : 125-130, 1997*